System Documentation

Zoom Driver

8051 compatible micro controller system for mechanical lens control /
DMX-512 / analogue in- output / keyboard and display units

1. First steps

Your Zoom Driver Firmware supports currently two modes of operation, namely manual operation for controlling the lens position via the attached keyboard or remote control. The device is equipped with a DMX-512 interface allowing the remote control of the zoom and focus lens position via two separate DMX-512 addresses[1]. The whole DMX-512 address space can be used, though it is advisable to use the lowest possible address appropriate for your application.
Both lenses for ZOOM and FOCUS can be operated fully independently from each other and movement of the lens elongation is simultaneous during ***Remote*** mode control.

The Zoom Driver is currently shipped with a backlighted 20 character by 4 row LCD display for status messages and user notification, an ***Operation*** status led (green) and a ***DMX-512 Signal*** control led (red). The backlight facility provides the possibility to edit the device settings even in dark environment and the backlight automatically fades out after 30s if no user interaction is detected by the system to avoid any light distortion.

[1] For further information on setting the DMX address or controlling the lens position via DMX-512 standard check section 3.3 – The DMX-512 interface or the appropriate section regarding the Zoom Driver firmware.

2. Installation guidelines

3. Assembly and Hardware

The following section is intended to make you familiar with the hardware groups setting up the ***Zoom Driver*** electronics. Primarily building the core of the electronics, the main CPU module is build around an Intel 8051™ compatible processor controlling the display and keyboard module and handling the user interaction. Secondly there are the peripheral units, the galvanic de-coupled DMX-512 interface section and the stepper control module setup around a Microchip PIC 16C72A™ processor and featuring a SDxP/IIC[2] interface.

3.1. Power Supply module

For mounting the module to your framework four drill holes with diameters fitted for M3 screws are provided near each corner of the module.
Connection to both stepper driver via 2 x 300mm single wire cable AWG 18. Pin #1 marked black (GND).

3.2. CPU core module - Motherboard

The CPU core module is built around an Infineon SAB 80C535™ processor taking full advantage of the built in serial communication feature and the ADC circuitry. The CPU core module additionally works also as a signal distribution matrix establishing all the links to the peripheral modules.

[2] SDxP ... Serial Data Exchange Protocol supports a serial data transmission via a two wire link and provides a transmission error checking on a checksum verification basis and is primarily intended for half duplex high speed data transmission between the CPU core and peripheral slaves.

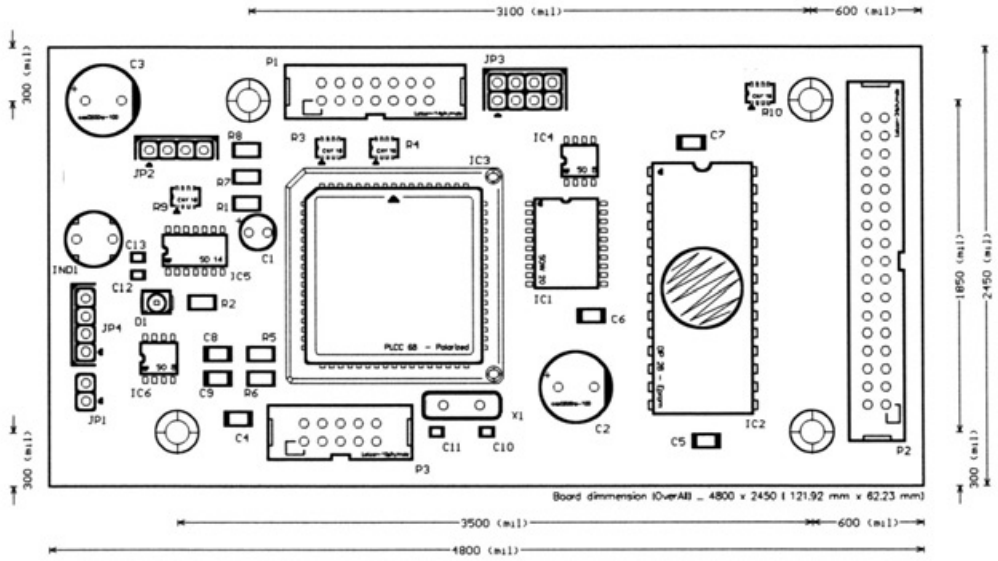


Fig. 1. CPU core module for the ZoomDriver AddOn with dimensions

Connect the display module to connector ***P1***, the DMX-512 interface to connector ***P3***, and the optional available expansion board for enhanced communication features including Ethernet networking to ***P2***. ***JP1*** is provided for warm starting the system and is intended only for service purposes. The stepper driver board featuring the power supply converters is connected to jumper ***JP3*** and the extension link to the end position switches is connected to ***JP2***. By establishing all the above mentioned links you are nearly done with all the setup work needed to get your system running.

For mounting the board to your framework four drill holes with diameters fitted for M3 screws are provided near each corner of the board.

3.3. Display and keyboard

Any user interaction is done via the keyboard and display unit providing four buttons for controlling the system in manual mode and doing all the setup work, like selecting the appropriate DMX address of the unit or other settings.

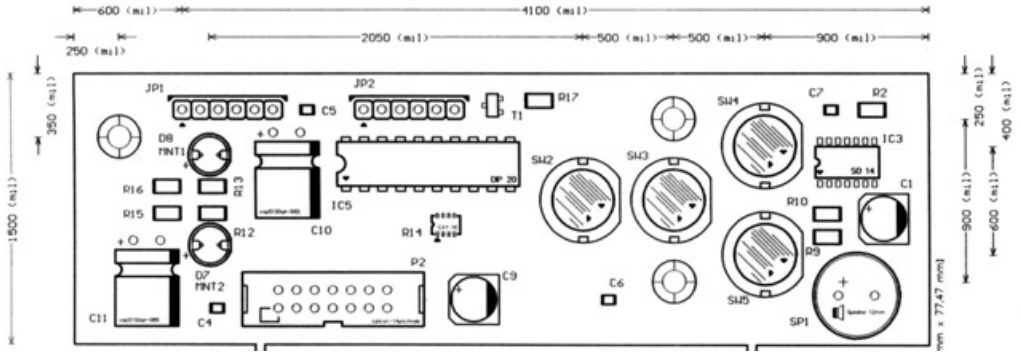


Fig. 2. Keyboard module for the ZoomDriver AddOn with dimensions

Above figure shows a section from the keyboard board including the buttons for user interaction, speaker ***SP1*** for command confirmation and signaling alert conditions and finally the 14 pin ribbon connector ***P1*** to the motherboard. All user relevant output is piped to a backlighted 20 character by 4 row LCD display.
Remove jumpers ***JP1*** and ***JP2*** on the LCD display module in case of not needing the automatic backpanel light facility. The backlight is automatically switched on in case of any user interaction and fades out after 30s when no button is pressed.

Connection to the motherboard via 150mm 14pin ribbon cable AWG 28. Pin #1 marked red
For mounting the board to your framework four drill holes with diameters fitted for M3 screws are provided in conjunction with the LCD display module.

3.4. DMX-512 interface

The DMX-512 interface is galvanic de-coupled and complies with the TIA/EIA-485 standard for multi-point bus communication and is conform to the USITT standard as pointed out in section 9.02 of the DMX-512 08/1990 standard. Internal circuitry features fail save termination and over-voltage protection. The Pin assignment of the XLR-5 connector is as follows

Pin 1	***Signal common (shield)***
Pin 2	***Dimmer drive complement (data 1 negative)***
Pin 3	***Dimmer drive true (data 1 positive)***
Pin 4	***Second channel complement (data 2 negative)***
Pin 5	***Second channel true (data 2 positive)***

The RS-485 multi-point transceiver interface ***IC4*** is mounted via a socket so replacement in case of line failure is easily done. Depending on the position of the device within the DMX-512 transmission bus[3] the interface has to be terminated to avoid signal distortion due to transmission line reflections[4].

[3] The RS-485 standard defines a maximum number of up to 32 devices per line segment to guarantee correct signal transmission within the driver specification.

[4] The correct termination resistor of 120Ω is assembled onto the DMX interface board, so termination is easily done by closing ***SW5***

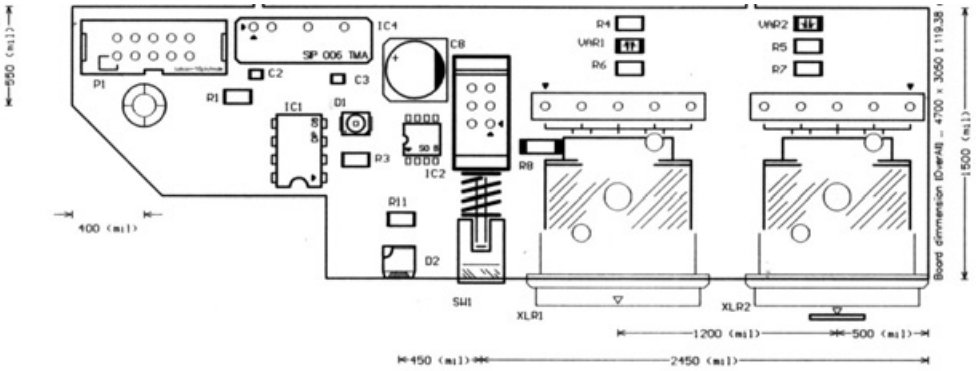


Fig. 3. DMX-512 interface module for the ZoomDriver AddOn with dimensions

Line termination status is flagged by led ***D2***. ***D2*** red light means line is terminated else line termination disabled. Termination status is changed via ***SW5***[5]. The link to the motherboard is established via a ribbon cable connected to ***P1***.

Connection to the motherboard via 300mm 10pin ribbon cable AWG 28. Pin #1 marked red
For mounting the board to your framework use drill holes with diameters fitted for M3 screws **provided by the XLR connectors.**

3.5. Stepper driver

The control of the Focus and Zoom lenses stepper is handled by two microstep driver boards. Both boards feature a SDxP/IIC[6] serial communication facility which is mastered by the main processor and are connected to the same bus in daisy chain manner – so use extra care when changing the board address in case of driver replacement.

[5] Use a small screwdriver to alter the termination status by shifting the nozzle of ***SW5***.

[6] The SDxP communication protocol handles checksum verification to avoid transmission errors due to noisy environment and provides data exchanges via a two wire interface.

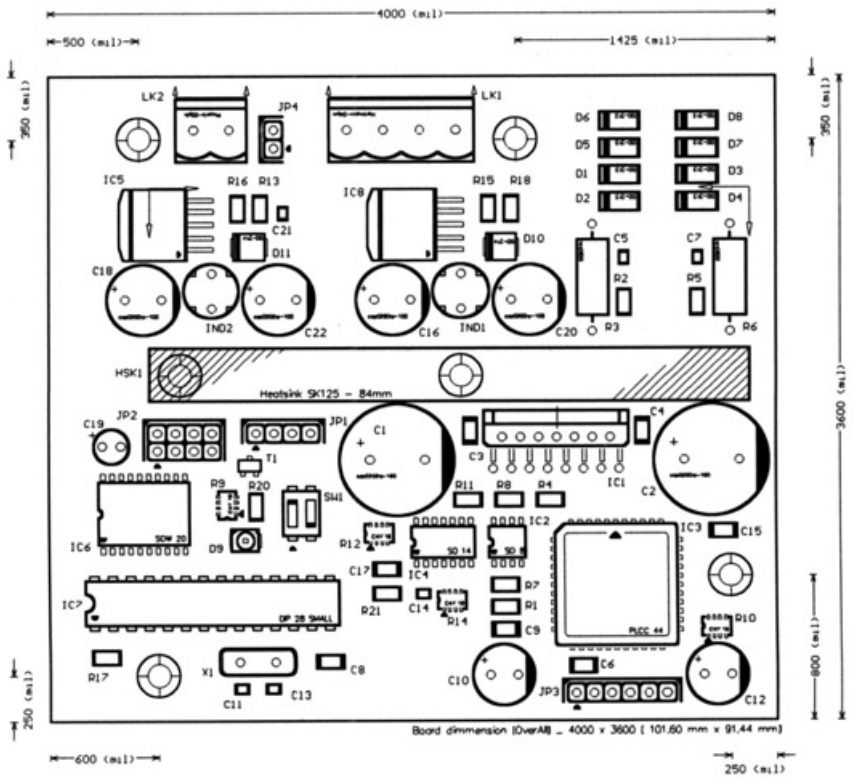


Fig. 4. Microstep driver module for the ZoomDriver AddOn with dimensions

The board is build around a Microchip PIC 16C72A™ RISC[7] processor which entirely handles the controlling of the stepper motor and the data communication. In case of correct command transmission led ***D11*** flashes prior to command execution. Additionally, the board provides all the

[7] RISC stands for Reduced Instruction Set Computer. The basic idee of a RISC machine lies in a simpler core architecture of the processor.

necessary voltage converters for the different power supply rails, including the logic supply. The voltage converter circuitry is based on Texas Instruments Simple Switcher™ technology.
The board is connected to a **+24V +/- 5%** power supply rail via connector ***LK2***. Connect the 2-phase stepper motor to ***LK1***. The motor is driven in bipolar mode, therefore observe correct wiring of the stepper coils to avoid damage to your hardware. Connection the motherboard is established via jumper ***JP1***, which also provides the power supply for the CPU core. Additional modules can be connected as daisy chains to jumper ***JP2***.

1. Setting the board address

An unique address has to be assigned to every board connected to the daisy chain, the board address can be altered via ***SW1*** according to the binary system[8]. *Please observe that eventually printings on the DIP switches may not match the order of magnitude for the binary numbering system – keep always in mind: LSB Ø rightmost switch, MSB Ø leftmost switch.*

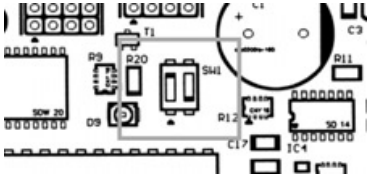


Fig. 5. Micro step driver section for setting the board address

Set the board address for the ZOOM assembly *(longitudinal movement)* to address 0x00 (both switches open). The address for the FOCUS lens *(rotational movement)* should be set to 0x01 (**MSB** – ***rightmost*** – to open, **LS**B – ***leftmost*** – to closed).

2. Stepper connector

The stepper motor is connected to the microstep stepper driver via LK1 a 4-pin Phoenix plug-in connector.
Stepper type: PK243AE-SG3.6 / PK243AE-SG10

[8] Within the Zoom Driver only address 00 and 01 is used, therefore all other settings result in male functions

Connection schemata for stepper wire: ***Yellow*** and ***white*** *(cut to 100mm)*
Blue, red, green and **black** (cut to 300mm)

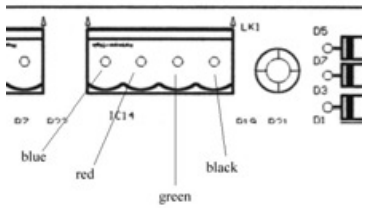


Fig. 6. Connector for the stepper motor with wiring legend

Colors and wiring scheme see above figure. Connect the remaining wires of the stepper motor in following manner – from left to right – ***blue, red, green*** and ***black*** wire.

For mounting the board to your framework four drill holes with diameters fitted for M3 screws are provided near the edges of the board.

Connection from board #1 (address 0x00) to the motherboard via 7 x 150mm single wire cable AWG 24. Pin #1 marked green.

Modifications board#1: Assemble the 4pin AMP Modu-2 connector **JP1**, provided with the AddOn kit.

Connection from board #2 (address 0x01) to board #1 via 4 x 100mm single wire cable AWG 24. Pin #1 marked black.

Modifications board#2: Remove cable 1 … 3 (green, red and black). Remove the 8pin AMP Modu-2 connector and replace it with the 4pin AMP Modu-2 connector, provided with the AddOn kit.

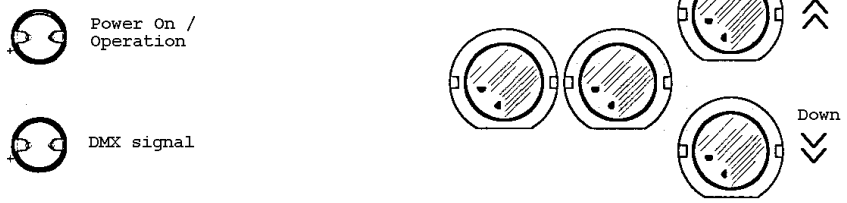
3.6. External link cable

Connect the external link cable to the motherboard jumper ***JP2*** and the end position switches. The end position switches must be **normally open (n.o.)** and **closing on action**. *Use the yellow/black branch for connection to the **ZOOM** switch (X motor- linear motion) and the orange/black one for the connection to the **FOCUS** switch (Y motor – rotational motion).*

Connection to the motherboard via 4 x 400mm single wire cable AWG 24.

4. Firmware

The following section introduces the firmware of the device and explains the operation modes and the altering of different settings via the menu functions. Primarily the device can be operated in ***Manual*** mode controlling the lens positions via the attached keyboard. Both lenses for focus and zoom can be operated independently from each other and movement can be simultaneously if needed. In ***Remote*** mode the device can be fully controlled via the DMX-512 interface. Two channels[9] must be reserved for controlling the zoom and focus lenses.
Before going deeper into the details of the firmware the keyboard layout and the functions of the different keyboard buttons[10] should be illustrated briefly.



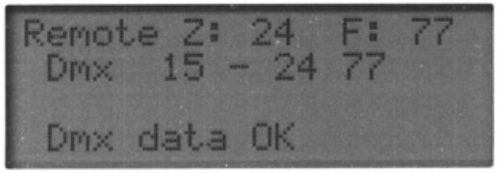
Immediately after powering on, the ***ZoomDriver*** firmware performs a short power-on self check, reloads the last recent parameter settings and initializes the zoom and focus lenses. When the lenses are initialized the device is ready for operation and you can change the system settings if necessary.

[9] Setting the DMX-512 base address to N for controlling the ZOOM lens, the device automatically reserves the address N+1 for the controlling of the FOCUS lens. The base address can be set within the range of 001 ... 511, so the complete DMX-512 address space is available, but it is strongly recommended to use the lowest possibly base address for remote control.

[10] Some of the keyboard buttons exhibit second level functions depending on the firmware status and the menu structure. The second level functions are cited in brackets.

4.1. Menu structure

Prior to discussing the different operation modes of the device, a brief note on the menu structure and the altering of the system setting will be helpful. Immediately after initializing the lenses, the device restores the operation mode, displaying the mode and mode relevant device information, like lens position, DMX address, ...



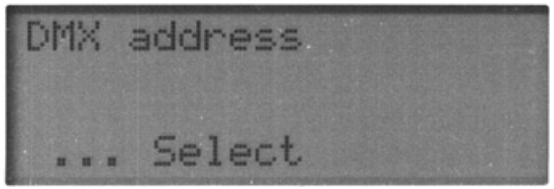
By pressing the ***Menu*** button the main menu pops up and you can move through the whole menu structure by pressing the ***Up*** and ***Down*** button. If you have done all your setup work just press the ***ESC*** button and the device resumes operation. During browsing the menu items and doing the setup work the device stalls all external operations.

Operation mode	***Use to select one of the available operation modes – MANUAL operation or REMOTE operation via DMX-512 protocol***
DMX address	***Use to change the DMX-512 base address of the ZoomDriver. Allows the changing of the DMX-512 default address and also changes the current DMX-512 address***
Acoustic	***Use to toggle the acoustic confirmation flag. When enabled every keyboard action is confirmed by a beep. When disabled no acoustic signals are available – except during alert condition and in case of male editing by the user.***
Reload defaults	***Use this entry to reset the device to factory default settings[11] – use with extra caution all your previously done settings will be lost and the device restarts with the factory pre-settings.***

[11] In case of having changed the settings in an unpredictable way and getting stuck on the way this is a very handy feature to void your current settings and getting started with the factory pre-settings. Except the DMX-512 address the factory pre-settings should match your needs for remotely controlling the ***ZoomDriver***.

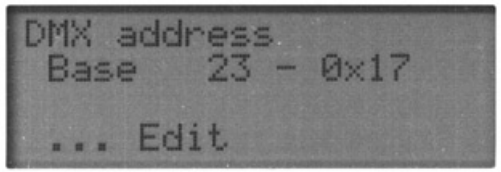
Diagnostics	***Given for testing the devices external functionality – use for testing the initialization switches and the stepper motor assembly and can be used as diagnostic mode if any male function occurs.***

The above table gives you an overlook on the available menu functions and a brief description of the entries. In the following example the altering of the DMX-512 base address settings has been chosen to illustrate the principal way of browsing the menu structure and altering any settings to customize the device performance according to your needs. In case of getting confused while browsing through the menu structure, pressing ***ESC*** twice[12] always takes you out of the menu tree and sets the device to the last selected operation mode.



If you like to do changes to the respective menu item just confirm your selection by pressing ***ENTER*** and the sub menu pops up giving you the opportunity of changing the relevant parameter settings. Now you either can changes the numerical parameters, toggle selections or just select one item out of a list of available items. The following deals with the numerical editing of the DMX-512 address.

[12] In case of eventual display failure, press *ESC* twice and wait for about 25s. The firmware will reset the display automatically and you can resume programming the device.



By pressing the ***Up*** or ***Down*** button you can now change the numerical value of the DMX-512 address. The DMX-512 address is displayed in normal decimal as well as in hexadecimal notation, so addresses given in hexadecimal notation can be easily entered without complicated conversion from the hexadecimal to the decimal numbering system. The input routines automatically validates the entered address and limits it to the given range[13]. When you have finished your changes just press the ***ENTER*** button to make the changes permanent, save them to the onboard EEPROM and make the current address the default[14] DMX-512 address. Press the ***ESC***[15] button twice to resume.

Proceed with all other settings and parameters the same way as shown within the DMX-512 address settings example.

By pressing the ENTER and ESC button simultaneously the device performs a Soft-Reset and starts with initializing the lens assembly.

IMPORTANT NOTE:
If you want to make your changes permanent you have to save them to the onboard EEPROM, otherwise they will be lost at the next power down.

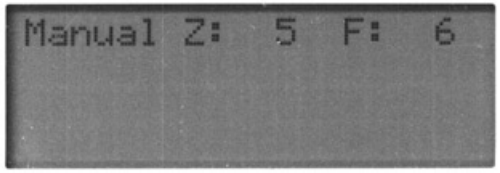
[13] An automatic roll-over functions provides a handy way to quickly change from lowest to highest DMX-512 addresses and vice versa. 000 – 511 and 511 – 000. The highest possible DMX-512 address of 511 is based on the fact, that the device reserves always two consecutive addresses and therefore a base address of 512 will cause male functioning of the device.

[14] The device will always start with the default settings after power up. So if you want your changes to be permanent you have to SAVE them to the onboard EEPROM and make them the default settings. If you do not change the changes to the EEPROM the device will operate with the current changes until the next power down and then reload the default settings from the EEPROM at power up.

[15] In case of getting stuck during editing of any settings or parameter pressing ***ESC*** always aborts the current editing and takes you up one menu level. Therefore pressing ***ESC*** twice gets you out of any editing and makes the device resumes normal operation.

4.2. Manual operation mode

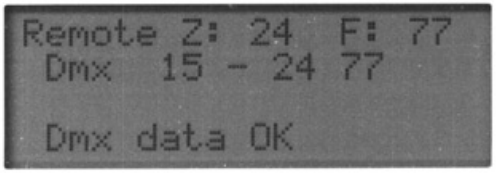
During ***Manual*** mode operation all incoming signals via the DMX-512 lines are ignored and the lens position is exclusively controlled via the keyboard. The percentage of the lens elongation is shown within the display for visual control and orientation.



Press the ***Up*** or ***Down*** button to control the ZOOM lenses, use the ***Up*** or ***Down*** button in combination with the ***Shift*** button to control the FOCUS lens. To enter ***Manual*** mode press the ***Menu*** button, confirm the ***operation mode*** menu item by pressing ***ENTER*** again and shift to ***Manual*** mode. Press ***ENTER*** if you want make your changes permanent and to save your changes to the onboard EEPROM. Finally press ***ESC*** twice to resume working.

4.3. Remote operation mode

In case of engaging ***Remote*** mode the device is entirely controlled via the DMX-512 interface lines. A DMX-512 value of 00 maps to a lens elongation of 00% and respectively 255 (0xFF hexadecimal notation) to an elongation to 100%. For proper functionality the device always needs to reserve two consecutive DMX-512 addresses. The lower address is used to control the ZOOM lens and the higher one for controlling the FOCUS lens.



To enter ***Remote*** mode press the ***Menu*** button, confirm the operation mode menu item by pressing ***ENTER*** again and shift to Remote mode. Press ***ENTER*** if you want to make your changes permanent and to save your changes to the onboard EEPROM. Finally press ***ESC*** twice to resume working.