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RGBW LED LIGHT FIXTURE WITH INTEGRATED DMX512 DRIVER

ABSTRACT *This paper discusses RGBW LED Lighting Fixture with integrated DMX512 driver. The presented design is characterized by high flexibility that allows to configure DMX universe in many different ways. The high power LED lamp with 4 colours and exchangeable optics ensures excellent optical control and efficient colour mixing.*

Keywords: *Lighting, LED, DMX512, Illumination.*

1. INTRODUCTION

Lighting systems with changing intensity and colour of luminaries have been commonly used in architecture to accentuate modern urban constructions. To control such system generally DMX512-A [1, 2] standard is applied. The U.S.Institute of Theatre Technology originally developed the DMX protocol as a standard interface between dimmers and consoles in theatres, but its simple concept was easily adopted by other users.

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LED lamps, due to its efficiency and ability to generate monochromatic light, is especially suitable for using it in wall-washers, accent luminaries and other architectural and advertising lighting.

The RGBW LED Lighting Fixture, that is presented here, combines in one device a multicolour LED lamp and DMX512A driver.

2. DEVICE ARCHITECTURE

In Figure 1 block diagram of device is presented. Its main components are: microcontroller, four constant current sources, LED lamp with lenses, RS485 receiver and transmitter.

The aim of microcontroller is to decode DMX signal, generate PWM waveforms for LEDs steering and prepare signal for next device in chain. The physical layer of DMX512A protocol is based on the balanced serial connection standard EIA-485-A [3], commonly named RS485, thus receiver and transmitter used in device are standard RS485 ICs. Constant current sources provide proper supply of LED lamp, to achieve different brightness levels sources they are switched on and off by PWM signals.

The light source is CREE MC-E RGBW LED. It is a multi-chip LED providing high lumen output and creating small optical source [4, 5].

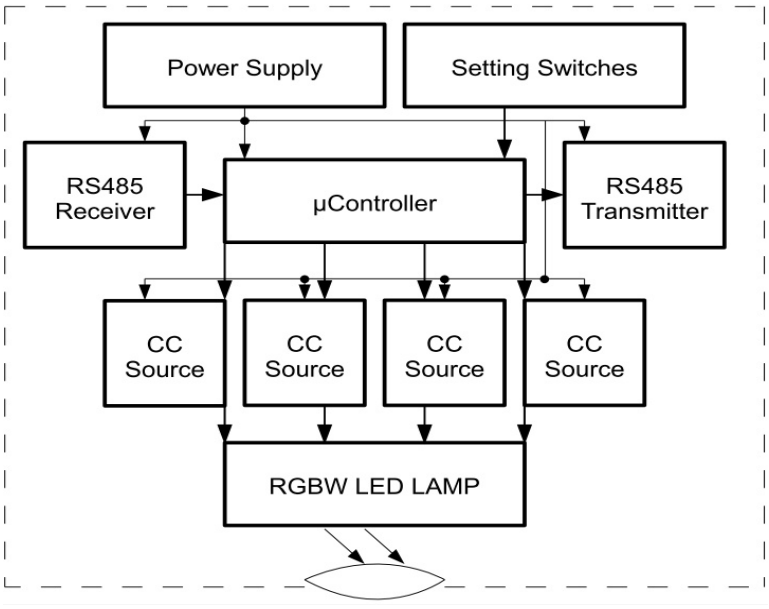

Fig. 1. Block diagram of device

3. DEVICE FEATURES

The device structure makes possible creating different addressing schemes with no need for controller or protocol modification. Devices can also work in legacy mode if needed. The addressing scheme differs form used in RDM (ANSI E1.20) [6], there is no bidirectional hazardous communication and no units unique numbering.

The addresses can be set by on-board switches, may duplicate previous fixture or follows numbers in the chain. The example for all these options in architectural lighting can be seen in Figure 2.

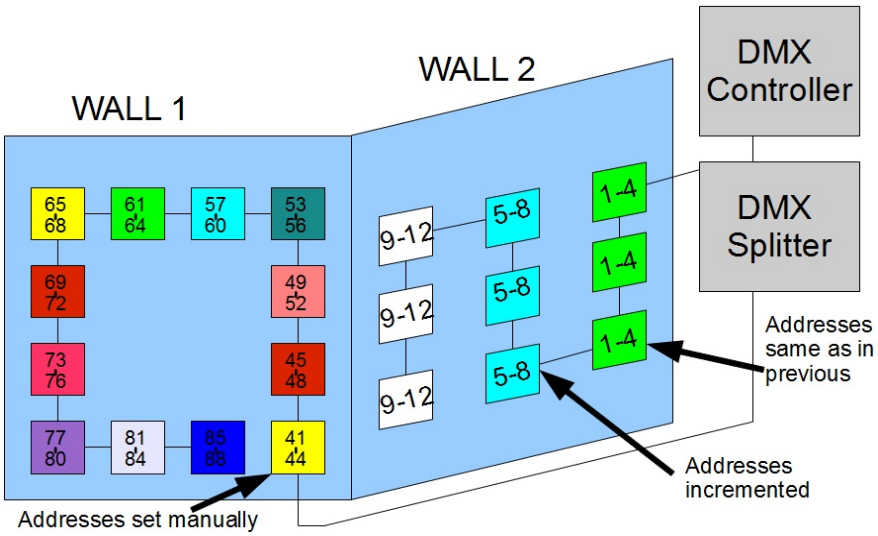

Fig. 2. Example of lighting system setup

The exchangeable optics (wide, narrow and oval beam shaped) allow to use presented fixture in different applications.

4. EXPERIMENTAL RESULTS

The prototype device is presented in Figure 3. On board 8-bit PIC microcontroller allows to achieve over 120 Hz PWM waveforms at constant current source control inputs. Proprietary auto-addressing functions can be realised in two ways: by modulating Break and MAB signals duration or by utilising SC data in DMX data packet (Tab. 1, Fig. 4).

There was also a model with ARM Cortex-M3 CPU built. That solution allowed to achieve over 1 kHz flicker free light modulation and integrating many extra features like scenes playing and recording.

Fig. 3. Prototype board picture

TABLE 1
DMX Packet elements

Element	Description	State	Size	Duration
Break	The Break resets the line, signaling a new DMX Packet.	LO (0)	22-250 kbits	88 µs - 1 sec
Mark After Break (**MAB**)	The MAB signals the receiver to begin reading data.	HI (1)	2-250 kbits	8 µs - 1 sec
Start Code (**SC**)	The SC is identical in size to channel data, but always 0 in value.	Mixed	11 bits	44 µs
Mark Time Between Frames (**MTBF**)	The MTBF is used to space out individual data bytes.	HI (1)	0-250 kbits	Up to 1 sec
Channel Data (**CD**)	The CD carries the 8-bit DMX Value for each channel, plus one start and two stop bits.	Mixed	11 bits	44 µs
Mark Time Between Packets (**MTBP**)	The MTBP is used to space out entire DMX Packets.	HI (1)	0-250 kbits	Up to 1 sec

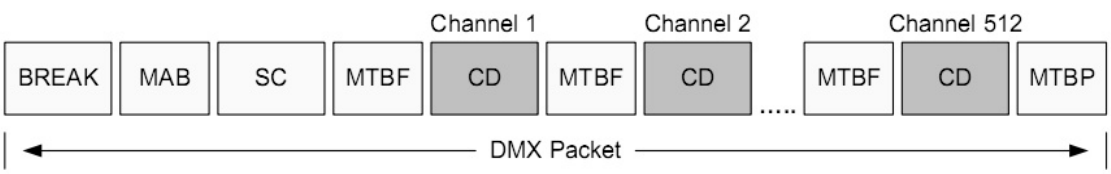

Fig. 4. DMX Packet description

Fig. 5. RGB Lighting of NIVISS office using 30 channels DMX Controller [8]

5. SUMMARY

In this paper the RGBW LED Lighting Fixture was presented. The device combines multicolour LED lamp with DMX512A driver. The discussed mechanism can be used in lighting systems to decorate attractively different architectural objects (example in Fig. 5). The presented design is characterized by high flexibility that allows to configure DMX universe in many different ways. The high power LED lamp with 4 colours and exchangeable optics ensures excellent optical control and efficient colour mixing.

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MODUŁ LED RGBW Z WBUDOWANYM STEROWNIKIEM DMX512

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STRESZCZENIE *W artykule jest przedstawiony moduł oświetleniowy oparty na diodzie RGBW LED z zintegrowanym sterownikiem obsługującym protokół DMX512. Projekt odznacza się wysoką elastycznością , która umożliwia skonfigurowanie oświetlanej sceny na wiele różnych sposobów. Zastosowana czterokolorowa dioda dużej mocy z wymienną optyka zapewnia doskonałe mieszanie i kontrolę uzyskiwanych barw.*

Tomasz CEGIELSKI received the M.S. degree in electronics engineering from the Warsaw University of Technology in 1998. He worked for the Telecommunication Research Institute in Warsaw and Gdansk from 1996 to 2006, specialized in the design of active, microwave circuits and devices for Radar systems. In 2005 and 2006, was member of NIAG group developing new NATO Sonobuoy Digital Telemetry Link standard. At Telemobile Electronics, Gdynia, Poland (2006-2009) he contributed to the development of Intelligent Automated Filter Tuning Tool. Since 2009, he is Chief Design Engineer at NIVISS, Gdynia, Poland – LED solution provider company. He is currently working toward the Ph.D. degree in electrical engineering from the Electrotechnical Institute, Warsaw, Poland.

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