

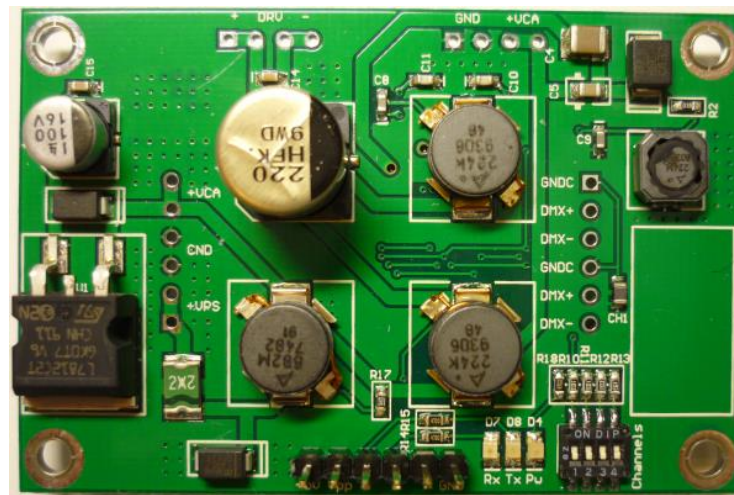
DMX512 DC Powerline Modem

User manual

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Firmware version: 0.3
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1. Introduction

A vast amount of DC low-voltage applications are DMX-driven. However, in most of the cases separate wiring is needed in order to transfer the DMX-frames. This can be an obstacle when upgrading existing systems which are already wired. A typical application is a set of pool lights. Colorized electrical bulbs are replaced by new DMX-driven LED-based systems, using the existing wiring. This DMX DC Powerline Modem makes it possible to transfer the DMX-frames throughout the DC power cables by means of Frequency Shift Keying (FSK) with a carrier frequency of 60 kHz and a transmission speed of 4800Bd. It avoids the need of separate wires. Because each device has its own address, the modem can be used in a broadcast network topology with one transmitter and multiple receivers.



2. Pinning (see: Connection diagram)

POWER INPUT/CABLE INPUT			
pin	connection	color	function
1	+VPS	Yellow	+ Power supply
2			
3	GND	Green	- Power supply - Cable input
4			
5	+VCA		+ Cable input
6			

DMX			
pin	connection	color	function
1	GNDC	Blue	DMX input GND
2	DMX+	Red	DMX input +
3	DMX-	Yellow	DMX input -
4	GNDC	Blue	DMX output GND
5	DMX+	Red	DMX output +
6	DMX-	Yellow	DMX output -

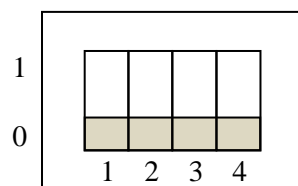
CABLE OUTPUT			
pin	connection	color	function
1	GND		- Cable output
2			
3	VCA		+ Cable output
4			

PROGRAM + TEST			
pin	connection	color	function
1	GND		Ground
2	RT		Receive/Transmit
3	C		Clock
4	D		Data
5	Vpp		Programming voltage
6	+5V		+5V output

DRV OUTPUT			
pin	connection	color	function
1	+VDRV	Red white	+ Driver output
2			
3	-VDRV	Blue	- Driver output
4			

3. Settings

The dipswitch is used for the selection between sender and receiver, and to set the number of channels that are transmitted. Every channel is 3 bytes long and could be used for transmitting the Red, Green and Blue color (RGB) of a lighting application. When the burst transmission time is longer than the DMX frame period applied at the sender, DMX frames are skipped. This can have a negative impact on the responsiveness of the system. It is recommended to transmit no more channels than necessary for the particular application for optimizing the performance. See Figure 1.



DIP SWITCH		
nr	function	
	0	1
1	C3	
2	C2	
3	C1	
4	receiver	sender

C3	C2	C1	channels	Burst length [Bytes]	Burst transmission time [ms]
0	0	0	1	9	15
0	0	1	2	13	21,67
0	1	0	3	15	25
0	1	1	4	19	31,67
1	0	0	5	21	35
1	0	1	6	25	41,67
1	1	0	7	27	45
1	1	1	8	31	51,67

For test purposes, the selection between sender (Tx) and receiver (Rx) can also be performed by grounding (Tx) or opening (Rx) the RT-pin of the PROGRAM + TEST connector.

The transmission time for one byte is: $4800bd^{-1} * 8 = 1,667ms$

Every transmitted burst is composed on:

- 3 bytes preamble (P)
- 2 bytes header (H)
- 3bytes/channel (example: R G B)
- 1 byte of next channel when an even number of channels is selected (X)
- 1byte checksum (C)

The first DMX-byte for light applications is always zero and will never be transmitted. It is automatically added at the receiver, and ignored by the sender. The payload of the FSK-burst, which is composed of the RGB bytes and the checksum, must always be an even number of bytes. It means that in case of an even number of channels is selected by the dip-switch, an additional byte of the consecutive channel will be automatically transmitted.

Some examples:

	one channel	two channels
DMX-sender input frame:	Z RGB	Z RGB RGB X
Transmitted FSK burst:	PPPHH {RG BC}	PPPHH {RG BR GB XC}
DMX-receiver output frame:	Z RGB	Z RGB RGB X

Figure 1 shows the transmission of one channel (9bytes). The DMX frame period is 40ms. The burst transmission time is 15ms. In this case, no frames are skipped.

- A: DMX signal at sender
- B: Frame detected at receiver
- C: FSK carrier, transmitted through the DC-line
- D: DMX reconstructed at receiver

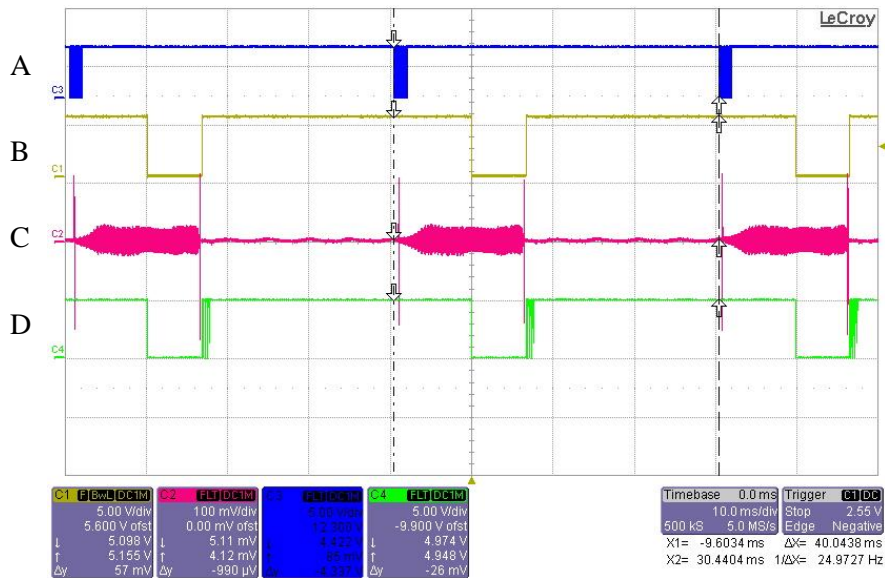


Figure 1: Scope image of input and output

Important note:

In order to transmit RGBW (additional white channel) you can use two consecutive RGB channels where the ‘R’ of the second channel presents the white byte. The ‘G’ and ‘B’ of the second channel must have the value 0x00. These two additional bytes need to be sent to the DMX transmitter because it waits before receiving all the bytes corresponding to the amount of channels that are selected by the dip switch before sending out any DMX packet on the power line.

4. LED indication

Three leds on the board indicate the status of the Powerline Modem:

Color	Action	Meaning	Action	Meaning
Yellow	permanent	power led	-	-
Red	during FSK-burst transmission	an FSK-burst is being transmitted	slow blinking	over temperature
Green	during DMX-frame transmission	an FSK-burst is received with valid checksum		

The green led is only on when the transmission of a complete burst was successful. In normal conditions, the repetitiveness of the DMX-frames invokes the blinking effect of the green led. Due to poor connectivity or interference, packet loss can occur and the blinking can be disturbed. This can reduce the responsiveness. For a good link, the green led has to blink very smooth and as fast as possible.

5. Protections

A. Temperature protection

When the temperature of the FSK chip is too high, the board goes into an alarm state. Bursts are no longer transmitted and the Red and Green leds are blinking slow and simulating. In that case, cool down and reset the board.

B. Current protection

A resettable fuse of 200mA is mounted on the board. It limits the current in case of short circuits or excessive currents on the board.

Important note:

An external 5A fuse needs to be used in order to protect the coils and the PCB in case of over-current in the power part of the circuit.

C. Reverse polarity protection

The +VPS power input has a polarity protection diode to ground. When wrong polarity is applied, the power supply must go as fast as possible into a short circuit protection mode before the diode and/or the circuit can be damaged:

$$I_{\text{fmax(cont)}} = 1\text{A}$$

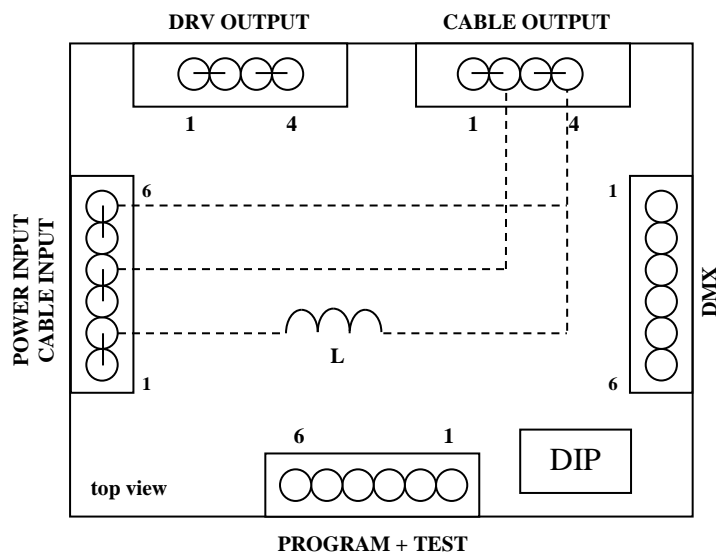
$$I_{\text{fpeak(10ms)}} = 60\text{A}$$

6. Connection diagram

A. Power Line Modem

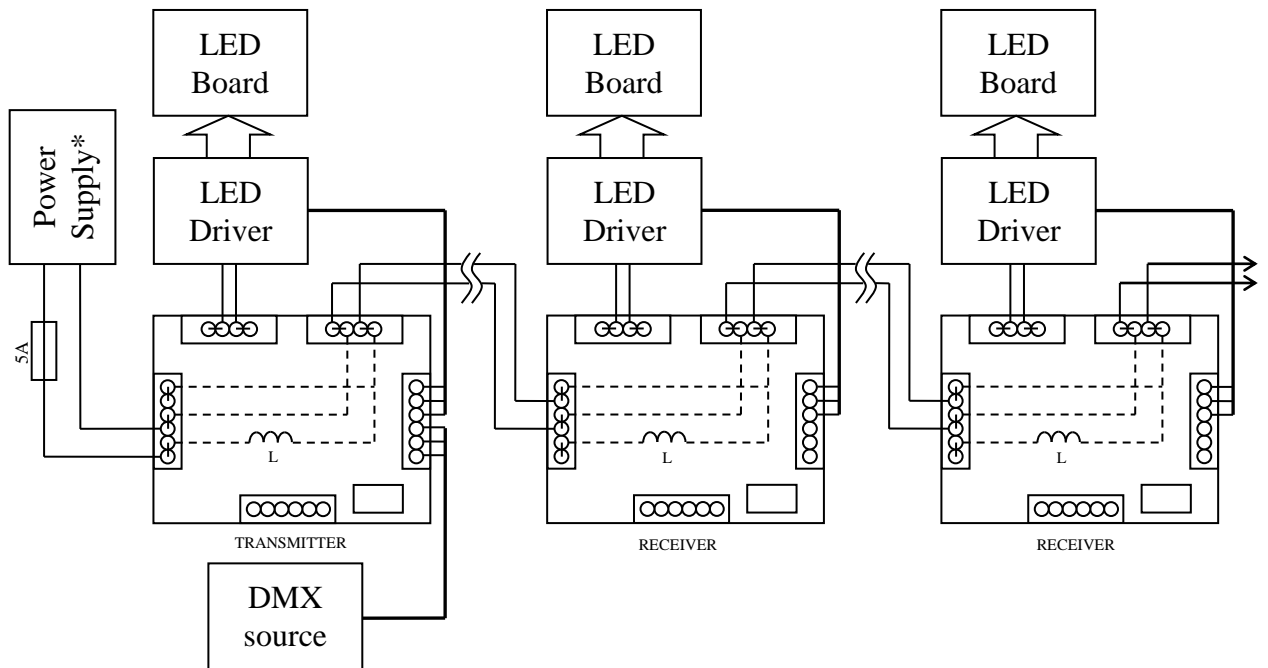
The Power Line Modem has several connectors:

POWER INPUT	For the power supply connection
CABLE INPUT	For the cable which comes from the previous modem
DRV OUTPUT	The power output for the driver, which contains an on-board EMC suppression circuit to avoid conductive emissions
CABLE OUTPUT	Cable output towards the next modem in the chain
DMX	For the DMX connection from the DMX source or DMX device. The DMX port on the modem is automatically configured as driver/receiver when the dip switch is selected as transmitter/receiver.
PROGRAM + TEST	The programming and test connector is only used for firmware upgrades and board testing. Note that the firmware is read protected, which makes unauthorized reproduction impossible.



B. Chain connection

The modems can be connected in a chain. The DMX source and power supply are connected to the transmitter board. Each LED-driver should be connected from the modem board for DMX and power. This power connection has an EMC supression output circuit which avoids that potential conductive emission from the switching circuits on the LED driver could not have some negative impact on the DMX powerline communication channel.



* Recommended power supply: Mean Well S-100F-24 (24VDC/4,5A)

Important note:

The power input must be protected with a 5A fuse.

7. Absolute maximum ratings

Voltage range	14 to 35VDC
Maximum current	4,7A/2pins on power input and cable connectors* 0,69A on driver output
Operating temperature range	0 to +70°C

*Recommended Power Supply: Mean Well S-100F-24 (24V/4,5A) for 7 LED-drivers of 700mA (4,9A) at 24VDC. The power inlet must be protected with a 5A fuse.

Important note:

The use of a short circuit protected power supply is recommended. Otherwise the reverse polarity diode and electronics will be damaged in case of reverse polarity, even when the 5A fuse is in the circuit chain.

8. Electrical characteristics

Power consumption	360 to 1200mW
Baud rate	4800Bd
Carrier frequency	60 kHz
Modulation type	Frequency Shift Keying
Deviation	1 kHz
Sensitivity	0,5mVrms

9. DMX512 characteristics

Mark after break	300µs
Inter byte gap	18,8µs
Mark before break	≥6500µs
Start bit	0
Stop bit	1
Start byte	0x00
Baud rate	250KBd
Receiver input impedance	12kohm not terminated*
Receiver input sensitivity	200mV
Receiver input hysteresis	50mV

* Because the input is not terminated, keep DMX wiring as short as possible