Matrix LED Headlight

Reference Guide

RD209-RGUIDE-01

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

Table of Contents

1. Introduction

This reference guide (hereinafter referred to as this guide) describes the specifications and operation procedure of the Matrix LED Headlight.

Active matrix LEDs are becoming increasingly popular, which detect pedestrians in front of automobiles and dynamically control headlight illumination in certain areas ahead. This Matrix LED Headlight reference circuit consists of two boards: a Headlight Power Supply Board (RD209-1) and a Headlight LED Board (RD209-2), which can be used together as an Active Matrix LED Headlight.

The Headlight Power Supply Board is powered by a 12-V power supply, and consists of 7 blocks of non-isolated switching boost circuits with constant-current (up to 500 mA) output. Each block can drive six LEDs, thus the whole power supply board can drive a total of 42 LEDs simultaneously. Dimming control of the LED is possible for each block by inputting a dimming signal from an external source. It is equipped with a linear power supply and can supply a 5.0 V constant voltage output with a maximum of 1.0 A to the MCU, etc. Power MOSFET XPN3R804NC and high-side power MOSFET driver TPD7104AF are used in the load switch circuit and reverse connection protection circuit to the system. A power MOSFET XPN2400ANC, a diode CMF02A for high-speed rectification, and a zener diode CUZ6V8 are used in the boost power supply circuit. A compact, low-on-resistance MOSFET SSM6K809R is used in the LED dimming control circuit. The 5V constant voltage power supply uses the regulator TB9005FNG for in-car CPUs and the bipolar transistor TTA005.

The Headlight LED Board has 42 LEDs arranged in a matrix on the board, and all of these LEDs can be individually lit and controlled by an external control signal. A small-signal MOSFET SSM6J808R, a transistor RN1907FE with a built-in bias resistor, and a zener diode XCUZ16V are used for the LED lighting control circuitry.

2. Specifications and Appearance

2.1. Specifications

Table 2.1 lists the main specifications of this reference circuit.

Table 2.1 Matrix LED Headlight Reference Circuit Specifications

Item	Specifications
Input voltage	12 V
Number of LEDs	42 LEDs (6 LEDs × 7 blocks, 6 blocks in white and 1 block in amber)
LED drive current	Up to 500 mA, dimming control is possible for each block
Power supply output for LED	Constant current 500 mA × 7 blocks
Power supply output for MCU	Constant voltage 5.0 V, Max. 1.0 A

2.2. Circuit Block Diagram

Fig. 2.1 shows the block diagram of this reference circuit.

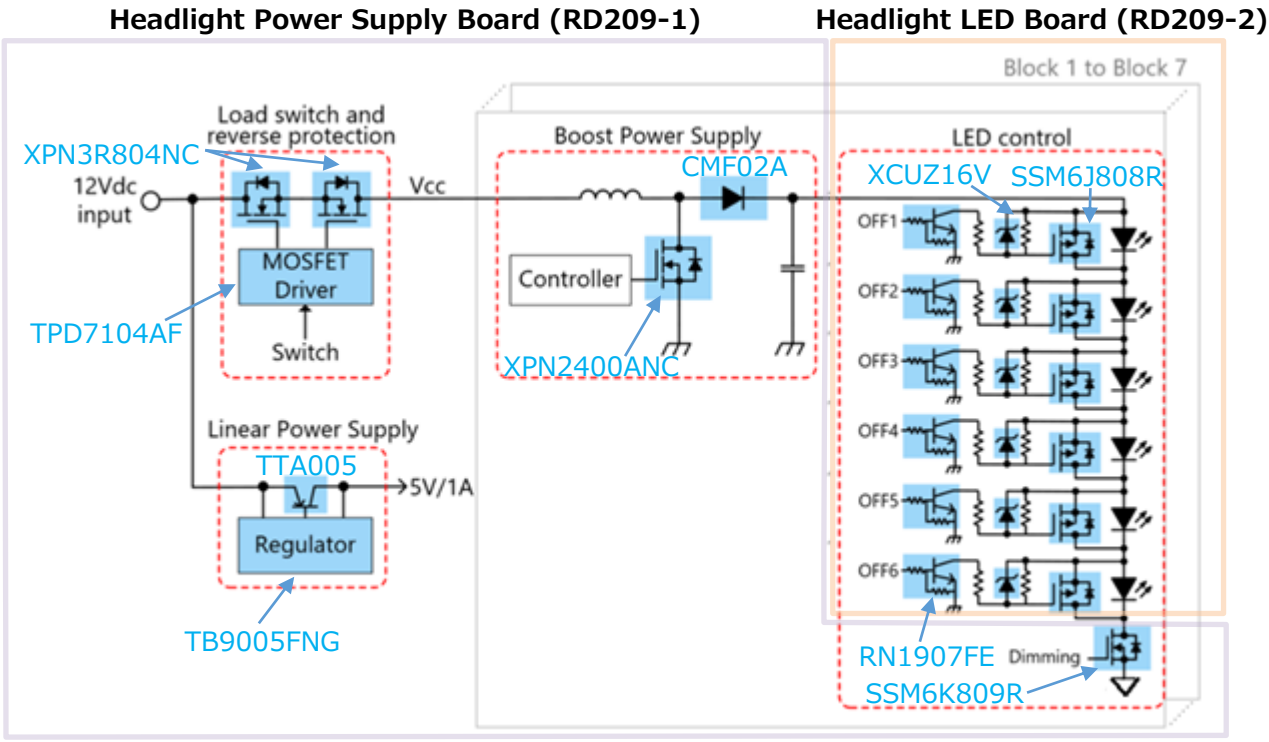
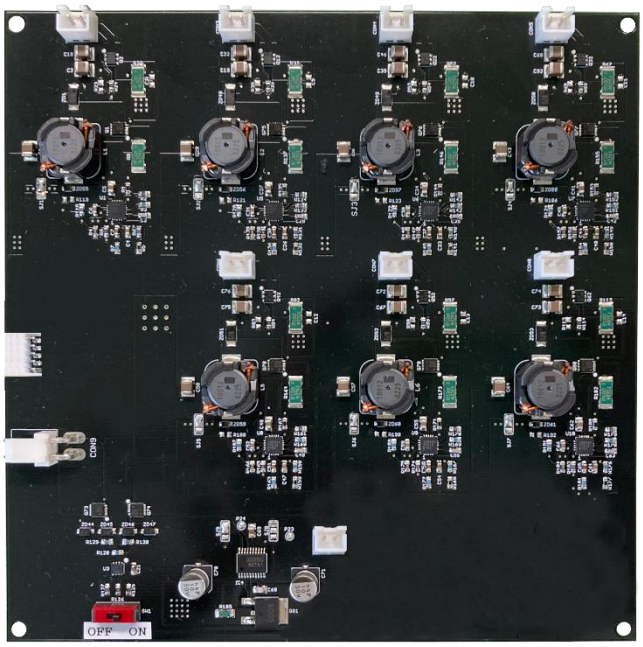


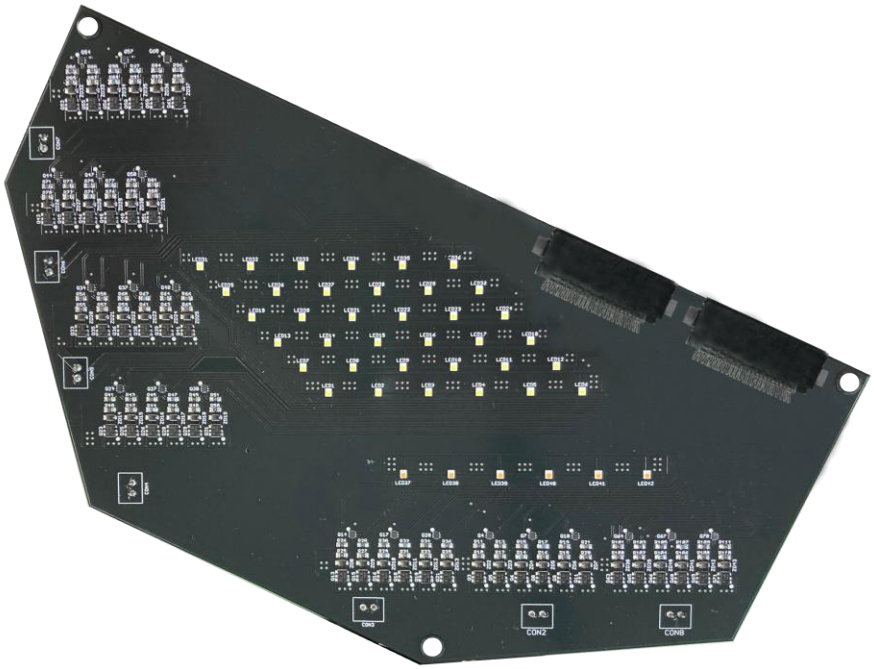
Fig. 2.1 Matrix LED Headlight Block Diagram

2.3. Appearance and Component Layout

Fig. 2.2 shows an external view of the Matrix LED Headlight boards and Fig. 2.3 shows the layout of the main components.

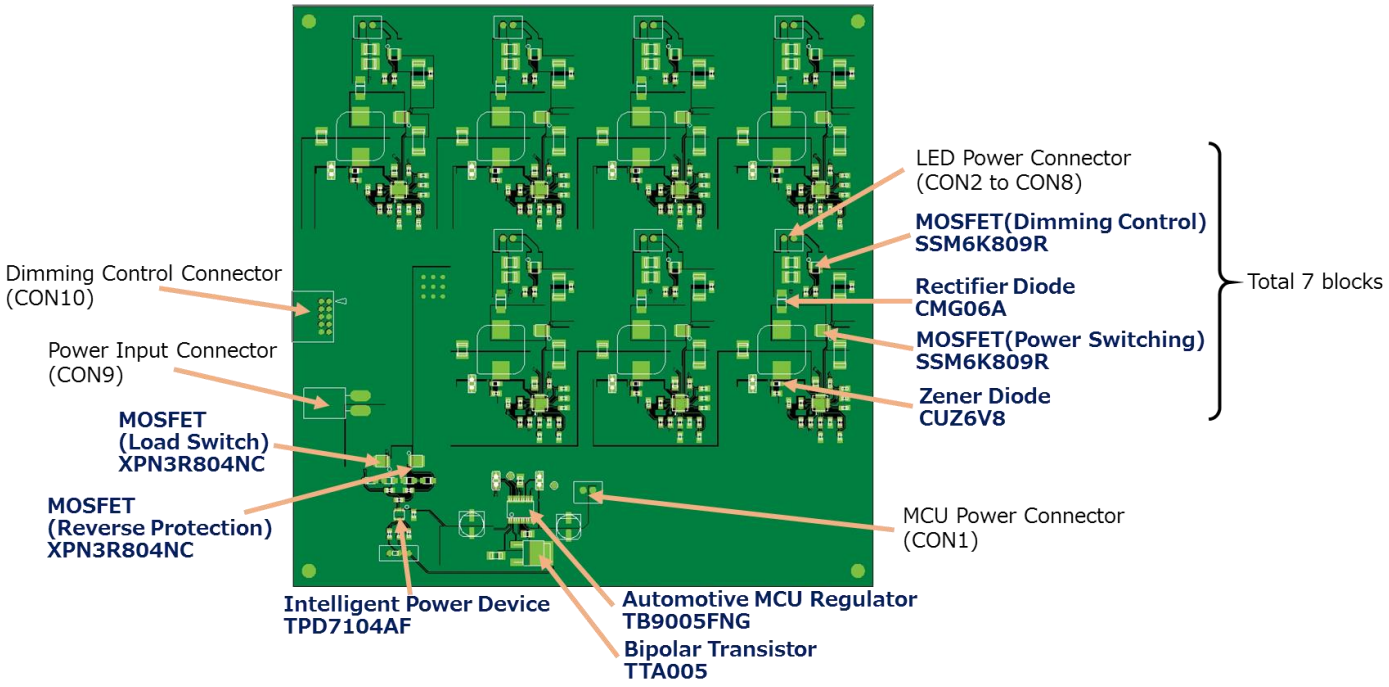


<Headlight Power Supply Board RD209-1>



<Headlight LED Board RD209-2>

Fig. 2.2 External View of Matrix LED Headlight Boards



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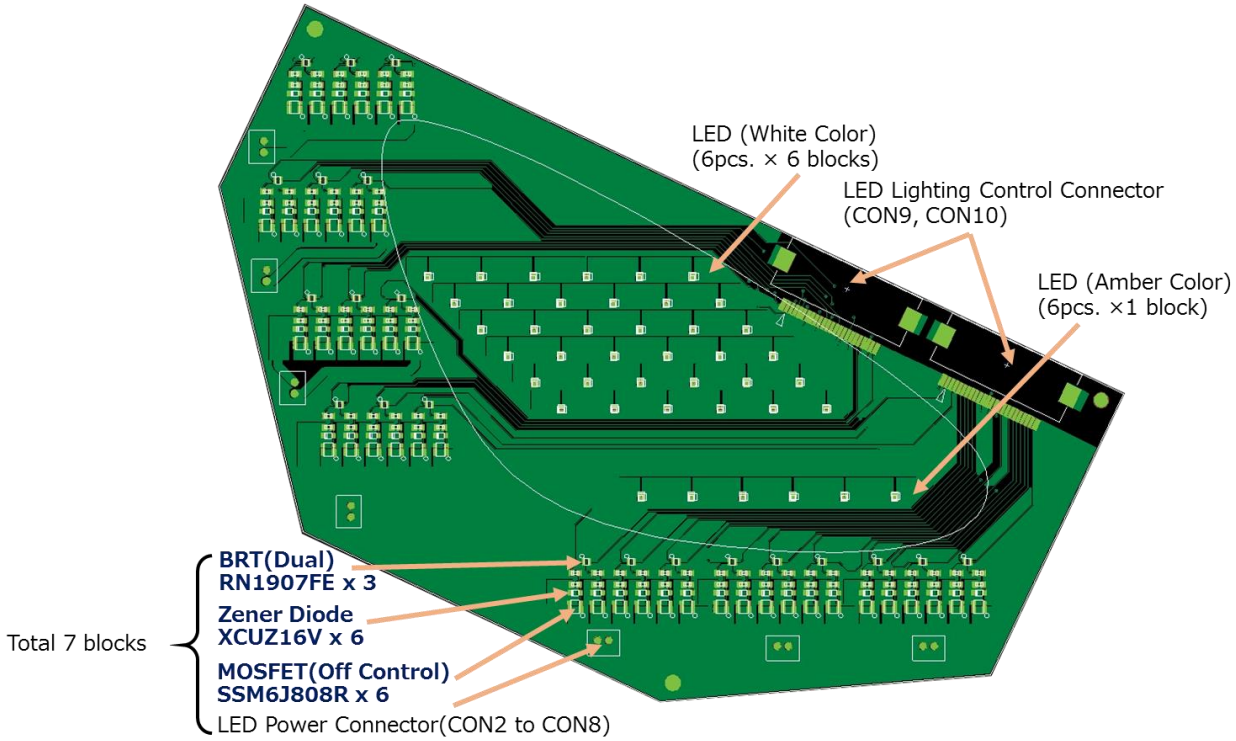


<Headlight LED Board RD209-2>

Fig. 2.3 Major Component Arrangement

3. Circuit Diagram, Bill of Material, and PCB Pattern Diagram

3.1. Circuit Diagram

Refer the following files:

Headlight Power Supply Board RD209-SCHEMATIC1-xx.pdf

Headlight LED board RD209-SCHEMATIC2-xx.pdf

(xx is the revision number)

3.2. Bill of Material

Refer the following files:

Headlight Power Supply Board RD209-BOM1-xx.pdf

Headlight LED board RD209-BOM2-xx.pdf

(xx is the revision number)

3.3. PCB Pattern Diagram

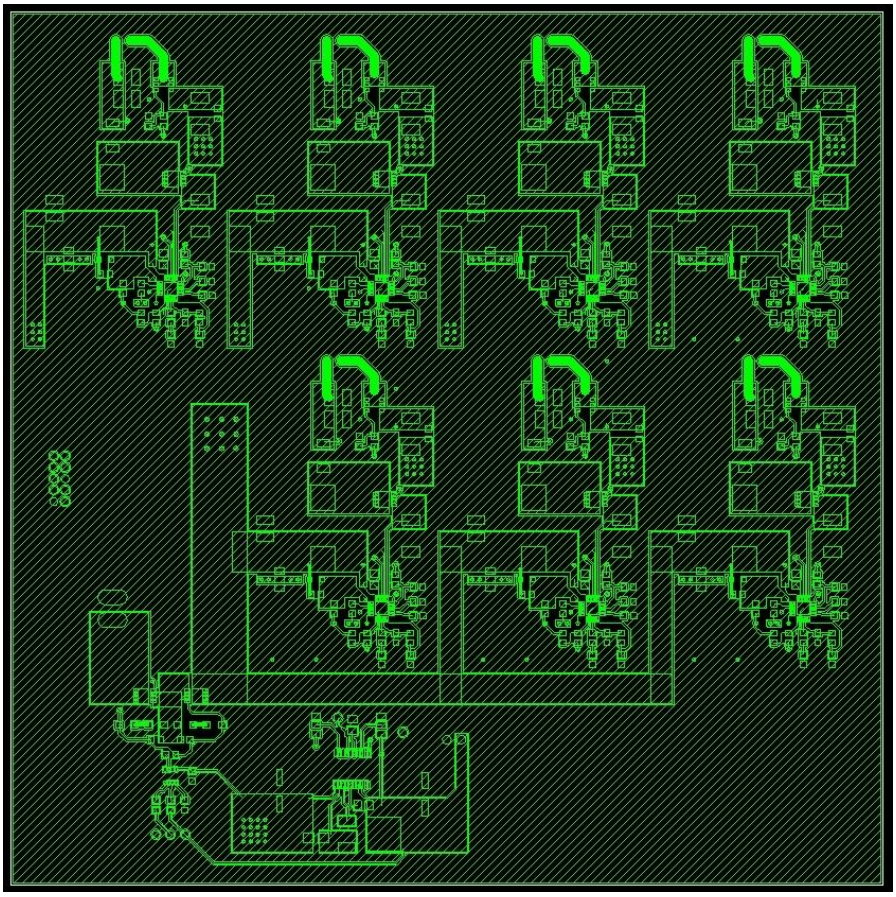
Fig. 3.1 shows the pattern diagram of the Headlight Power Supply Board, and Fig. 3.2 shows the pattern diagram of the Headlight LED Board.

Also refer to the following files:

Headlight Power Supply Board RD209-LAYER1-xx.pdf

Headlight LED board RD209-LAYER2-xx.pdf

(xx is the revision number)



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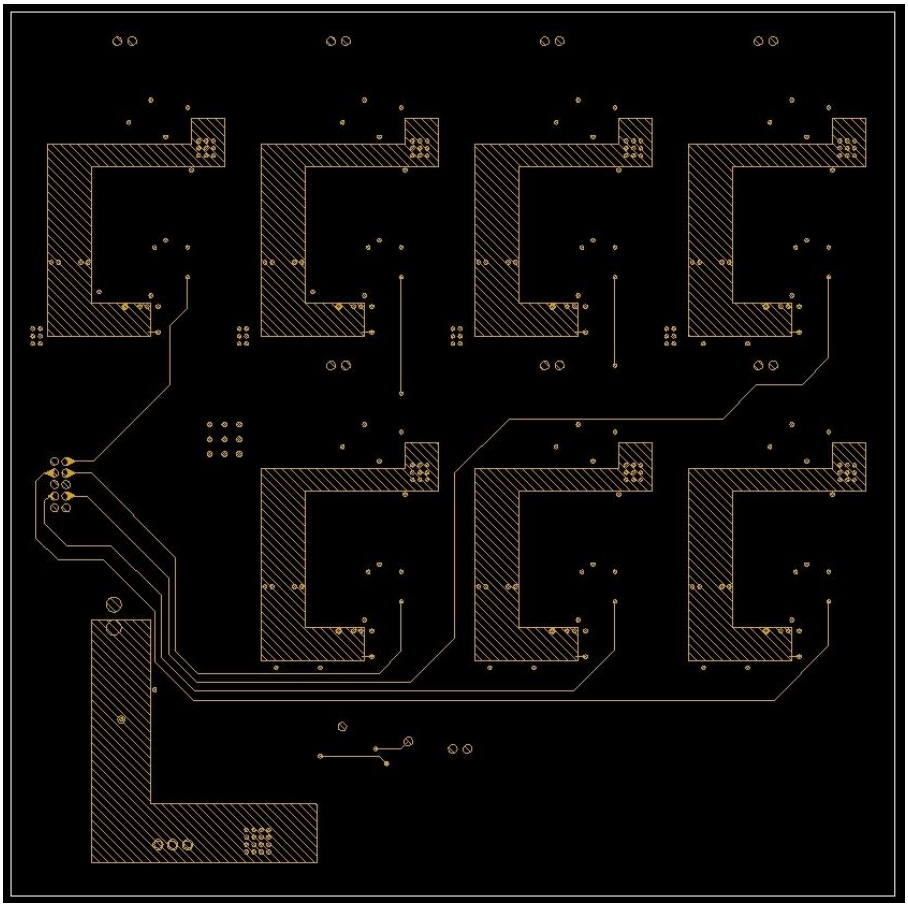

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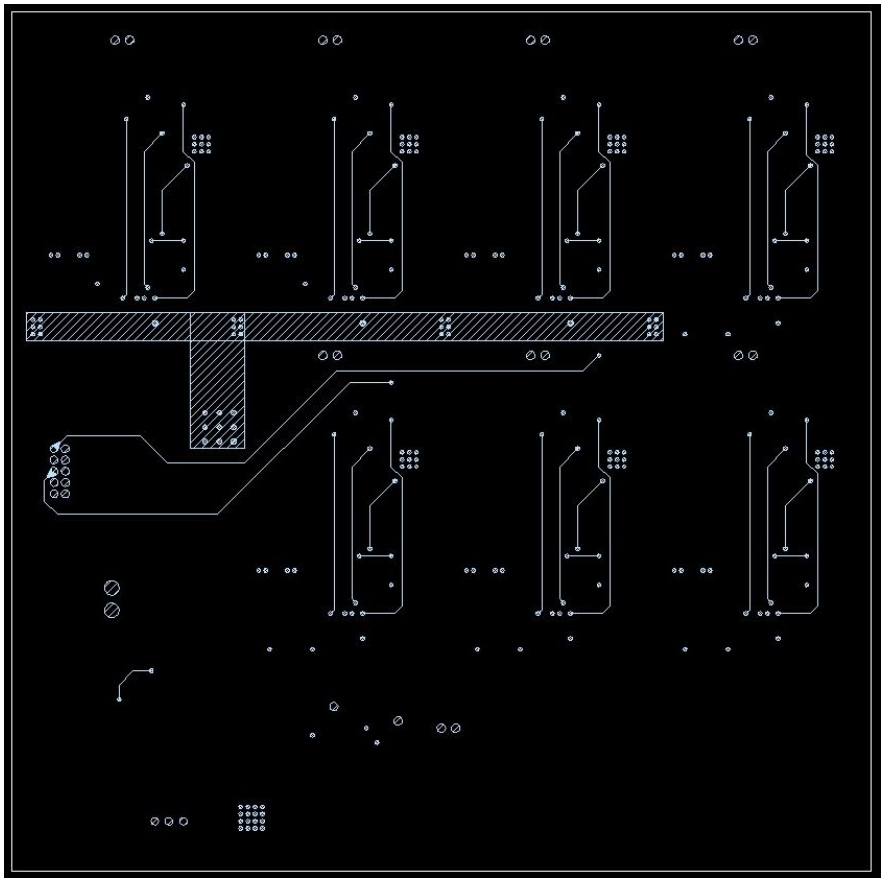

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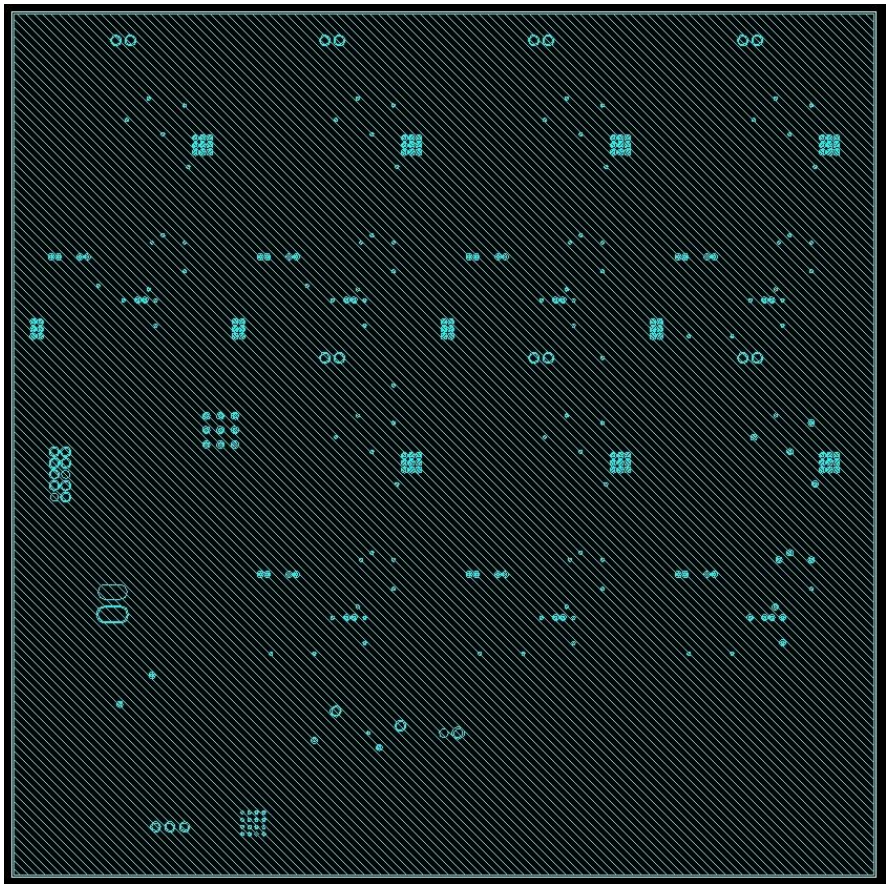

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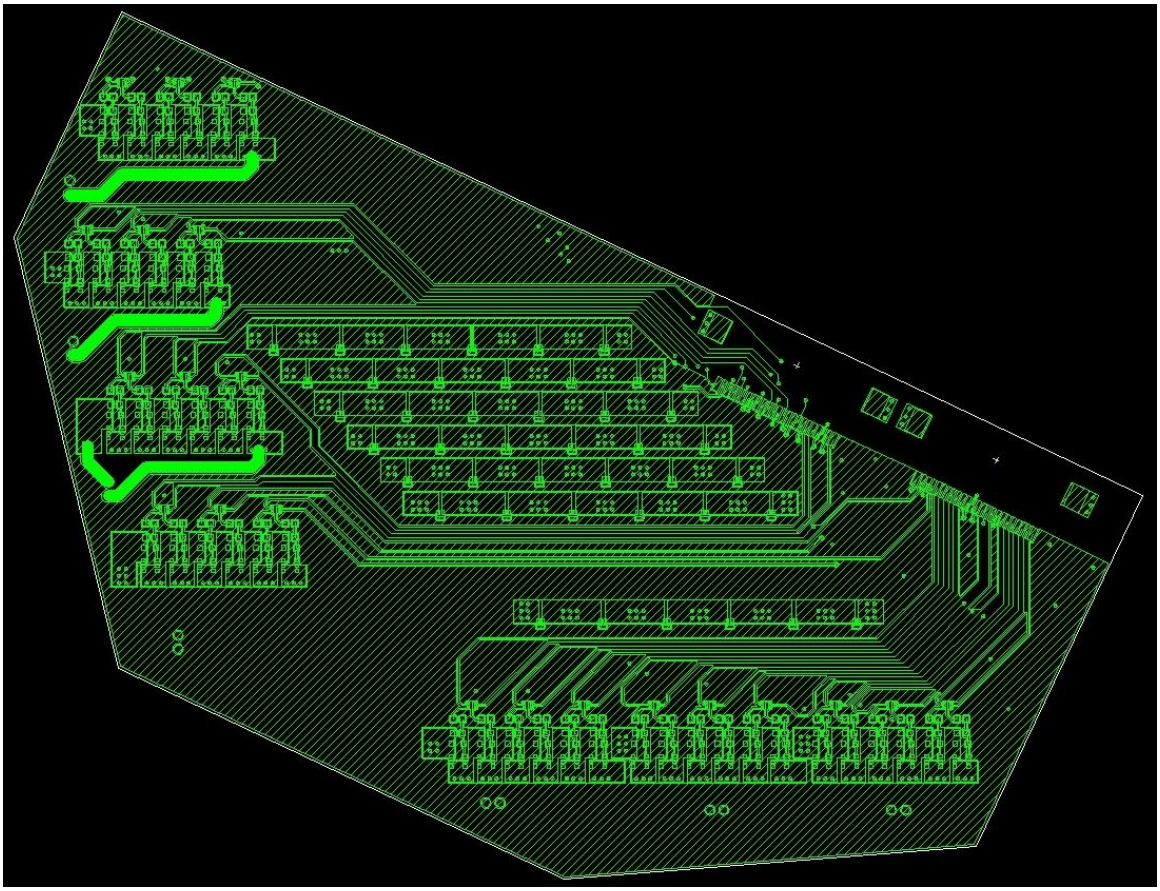
Fig. 3.1. Board Pattern Diagram (Headlight Power Supply Board)



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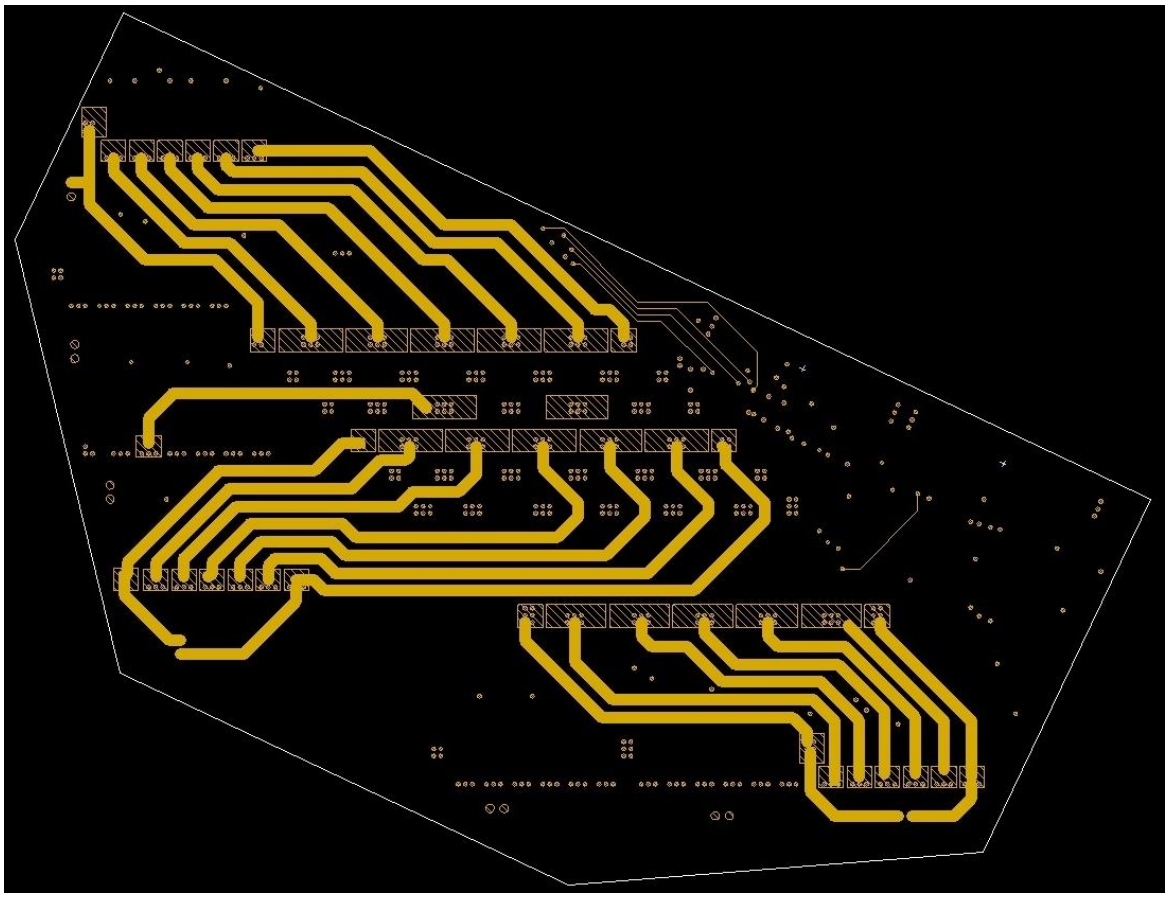

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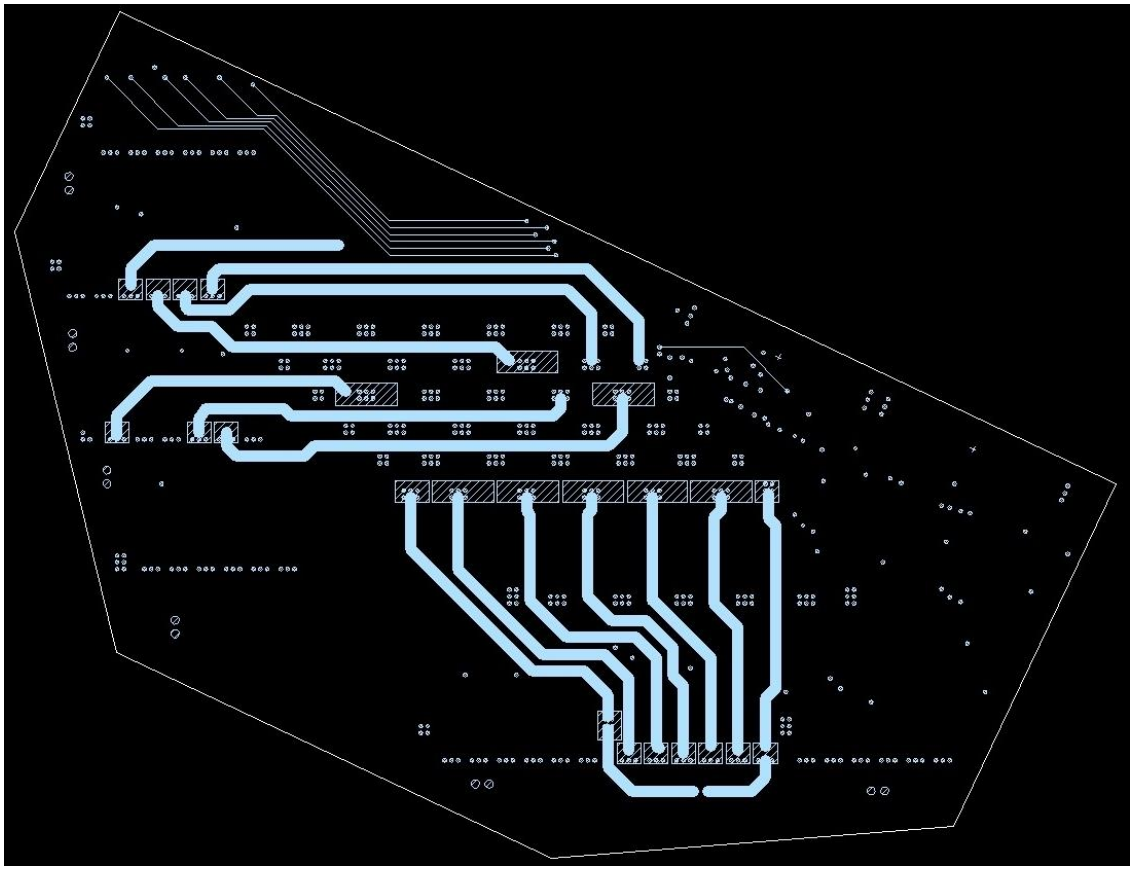

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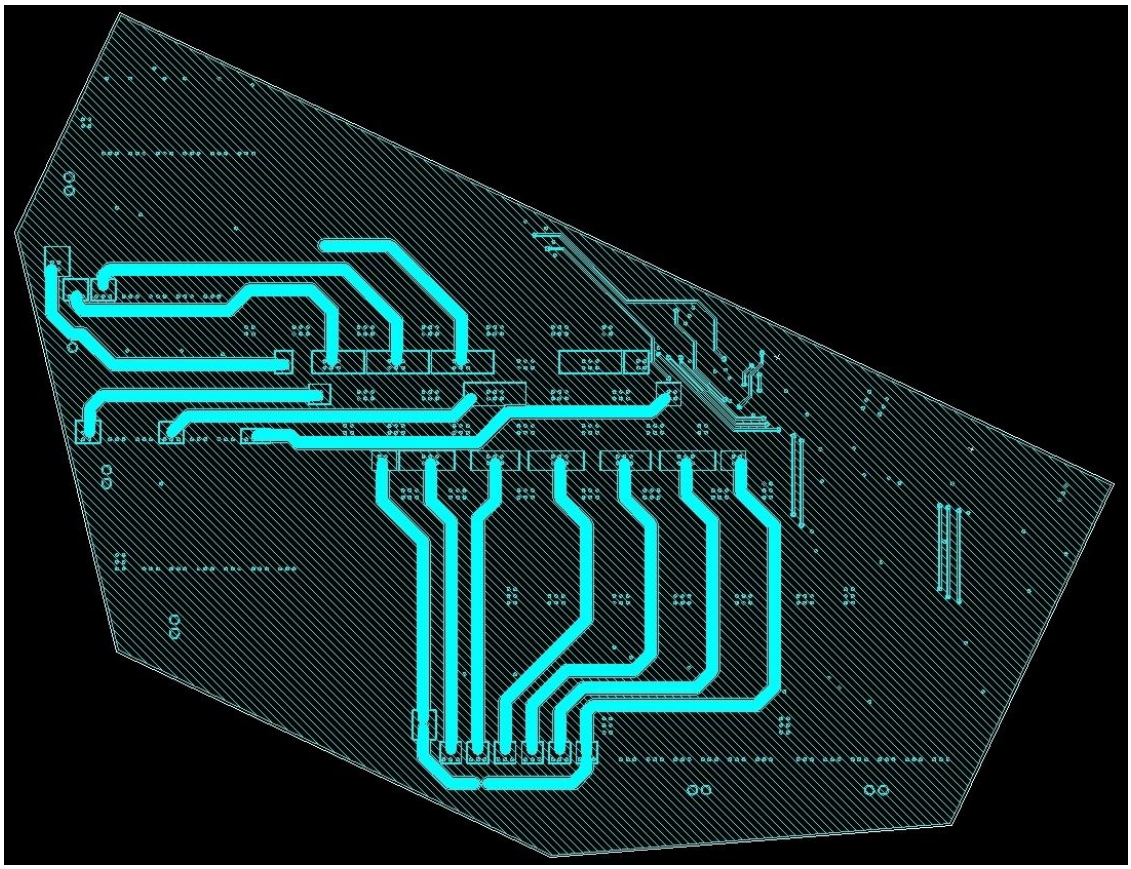

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Fig. 3.2 Board Pattern Diagram (Headlight LED Board)

4. Description of Reference Circuit Operation

4.1. Connecting to External Devices

Connect to external devices as shown in Fig. 4.1.

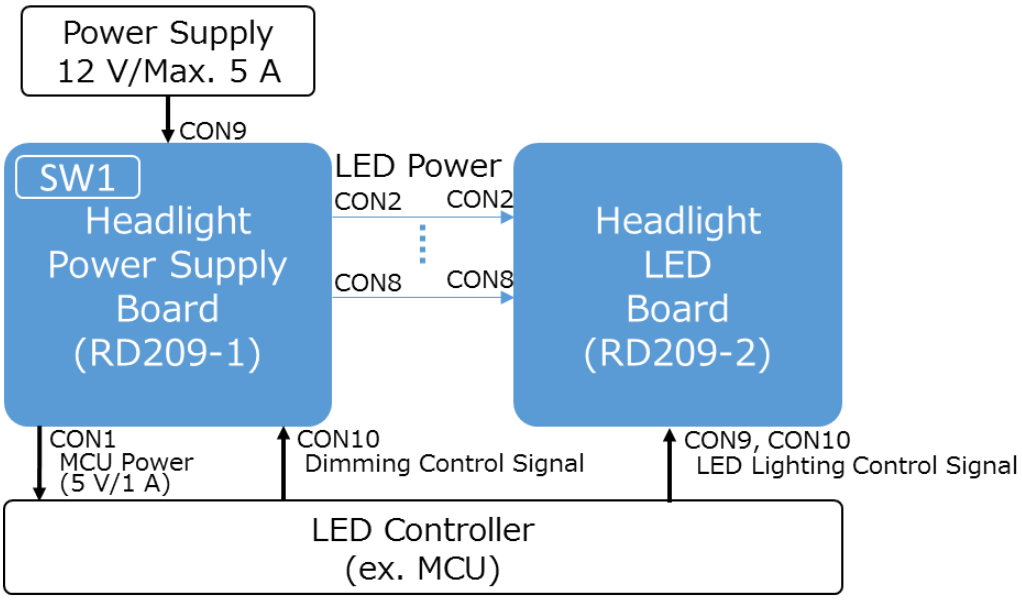

Fig. 4.1 Connection between each BOARD and the Outside

Use a power supply with as little noise as possible and stable operation.

4.2. Connector Specifications

The connector specifications of this reference circuit are as follows.

Table 4.1 Headlight Power Supply Board (RD209-1) Connector Specifications

Pin	Name	Description
1	+12V	Power input (12 V)
2	GND	Ground

CON9: Power In

Pin	Name	Description
1	LED-	LED power -
2	LED+	LED power +

CON2 to CON8: LED Power Out (Block 1 to Block 7)

Pin	Name	Description	Pin	Name	Description
1	PWMDIM1	LED dimming control (Block 1)	6	PWMDIM2	LED dimming (Block 2)
2	PWMDIM3	LED dimming (Block 3)	7	PWMDIM4	LED dimming (Block 4)
3	PWMDIM5	LED dimming (Block 5)	8	PWMDIM6	LED dimming (Block 6)
4	PWMDIM7	LED dimming (Block 7)	9	(n.c.)	-
5	GND	Ground	10	GND	Ground

CON10: LED Dimming Control

Pin	Name	Description
1	+5V	MCU power output (5 V)
2	GND	Ground

CON1: MCU Power Out

Table 4.2 Headlight LED Board (RD209-2) Connector Specifications

Pin	Name	Description
1	LED-	LED power -
2	LED+	LED power +

CON2 to CON8: LED Power In (Block 1 to Block 7)

Pin	Name	Description	Pin	Name	Description
1	LED31	LED off control (Block 6, Step 6)	13	LED32	LED off control (Block 6, Step 5)
2	LED33	LED off control (Block 6, Step 4)	14	LED34	LED off control (Block 6, Step 3)
3	LED35	LED off control (Block 6, Step 2)	15	LED36	LED off control (Block 6, Step 1)
4	GND	Ground	16	LED25	LED off control (Block 5, Step 6)
5	LED26	LED off control (Block 5, Step 5)	17	LED27	LED off control (Block 5, Step 4)
6	LED28	LED off control (Block 5, Step 3)	18	LED29	LED off control (Block 5, Step 2)
7	LED30	LED off control (Block 5, Step 1)	19	GND	Ground
8	LED19	LED off control (Block 4, Step 6)	20	LED20	LED off control (Block 4, Step 5)
9	LED21	LED off control (Block 4, Step 4)	21	LED22	LED off control (Block 4, Step 3)
10	LED23	LED off control (Block 4, Step 2)	22	LED24	LED off control (Block 4, Step 1)
11	GND	Ground	23	LED13	LED off control (Block 3, Step 6)
12	LED14	LED off control (Block 3, Step 5)	24	LED15	LED off control (Block 3, Step 4)

CON9: LED Control 1

Pin	Name	Description	Pin	Name	Description
1	LED16	LED off control (Block 3, Step 3)	13	LED17	LED off control (Block 3, Step 2)
2	LED18	LED off control (Block 3, Step 1)	14	GND	Ground
3	LED7	LED off control (Block 2, Step 6)	15	LED8	LED off control (Block 2, Step 5)
4	LED9	LED off control (Block 2, Step 4)	16	LED10	LED off control (Block 2, Step 3)
5	LED11	LED off control (Block 2, Step 2)	17	LED12	LED off control (Block 2, Step 1)
6	GND	Ground	18	LED1	LED off control (Block 1, Step 6)
7	LED2	LED off control (Block 1, Step 5)	19	LED3	LED off control (Block 1, Step 4)
8	LED4	LED off control (Block 1, Step 3)	20	LED5	LED off control (Block 1, Step 2)
9	LED6	LED off control (Block 1, Step 1)	21	GND	Ground
10	LED37	LED off control (Block 7, Step 6)	22	LED38	LED off control (Block 7, Step 5)
11	LED39	LED off control (Block 7, Step 4)	23	LED40	LED off control (Block 7, Step 3)
12	LED41	LED off control (Block 7, Step 2)	24	LED42	LED off control (Block 7, Step 1)

CON10: LED Control 2

4.3. Starting and Stopping

The standard procedure for activating this reference circuit is as follows.

1. Turn the power supply on. At this time, the MCU power is output regardless of SW1 status.
2. After the signal is output from the LED control unit, turn on the switch (SW1) of the headlight LED power supply board.
3. Please change LED lighting control signal and LED dimming control signal according to the required LED control.

To stop, turn off the power after turning off SW1.

4.4. Precautions while Using

The voltage generated by the Headlight Power Supply Board may be 50 V or more, so be careful of electric shock, etc.

Pay attention to heat generation of major components such as LEDs.

Pay attention to retinal damage caused by LED brightness, etc.

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