User’s Manual

EZ-0006

78K0/IA2 PWM Evaluation Board for HBLED

Target Device

78K0/IA2 Microcontroller

ZBB-CE-09-0010-E

Data Published March 2009

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Safety Precautions

This document explains matters to be noted for safe use of 78K0/IA2 PWM Evaluation Board for HBLED. Be sure to read this document before using 78K0/IA2 PWM Evaluation Board for HBLED.

- Be sure to observe all dangers, warnings, cautions, and other instructions contained herein when using this evaluation board.
- This document should be kept handy at all times for ready reference.

Symbols used

This document uses the following symbols for matters to be observed for the safe use of the unit.

The symbols are followed by a brief explanation of the possible extent of problems which may occur if the notices are not observed.

Danger	The user may suffer death or serious injury and it's risk is high if the warning is not observed.
Warning	The user may suffer death or serious injury if the warning is not observed.
Caution	Human injury or property damage may occur if the caution is not observed.

The following symbols express matters which are prohibited in order to prevent injury or accident.

General prohibition The action mentioned is prohibited.	**Do not touch** Touching the specified location may cause injury.	**Do not disassemble** Disassembly may cause a problem such as electrical shock or product failure.
Keep away from water Use near water poses the risk of electrical shock or product failure if moisture were to contact the unit.	**Flammable** A nearby flame may cause the unit to catch fire.	**Do not touch with wet hands** Touching with wet hands may cause electric shock or product failure.

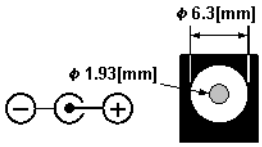
The following symbols are used for cautions to prevent product failure and accidents.

General caution Unspecified general cautions.	**Caution Hot** Human injury by high temperature may occur.

The following symbols are used for instructions to prevent product failure and accidents.

Compulsory action based on an instruction for the user.	Instruction to unplug the AC adapter.

Warnings

Warning	
	**Do not use this board in the purpose except the evaluation of MCU.** This board does not take safety measures or anti-EMI measures required for lighting equipment.
	**Do not heat the board or expose it to fire, and do not short the terminals.** Doing so may cause product failure, generation of heat, fire, or rupture.
	**Do not disassemble or modify the board.** Doing so may cause product failure, emission of smoke, fire, or electric shock.
	**Do not touch with wet hands.** Doing so while power is supplied cause product failure or electrical shock.
	**Do not drop or jolt the board.** Doing so may break or damage the board, causing fire or electric shock.
	Do not turn on power switch in insufficient state of cable connection such as AC adapter, interface cable. Doing so may cause product failure, generation of heat, fire or electric shock.
	Do not plug in or unplug a connector or cable with power applied to the board. Doing so may cause product failure, generation of heat, fire or rupture.
	Do not carry this board with connecting AC adapter and any cable. Doing so may cause damage of cable and cause product failure, generation of heat, fire or electric shock.
	**Use this board with spacer and on the isolated bench.** In case conductor contact to the board, it may cause product failure, generation of heat, fire or electric shock.
	Use AC adapter adapted to safety standard of each county. Using non-adopt AC adapter cause product failure, generation of heat, fire or electric shock.
	Use specified power supply. Using power supply except specified cause product failure, generation of heat, fire or electric shock.
	Use AC adapter with following size and polarity of DC plug. Using another type of AC adapter may cause product failure, generation of heat, fire or electric shock. 
	Confirm the outlet is near this board and easily unplugged.
	**If smoke or an abnormal smell or sound is emitted, or heating occurs, promptly switch off the board power and unplug from AC power supply.** Using the board in such a state poses a risk of fire, burning, or electric shock.

Cautions

Caution	
	**Do not use or store this board in any of the following locations.** - Environments with copious water, humidity, steam, dust, fumes, etc. - Environments where static electricity or electrical noise is readily generated. Such influences can lead to electric shock or product failure. In case liquid enters the board, cut the power supply, and consult your dealer or NEC Electronics sales representative. Even if the unit appears to be dry, internal moisture may remain.
	**To prevent static electricity damage, guard against energizing when touching metal parts such as the connector.** Static electricity can cause product failure.

CONTENTS

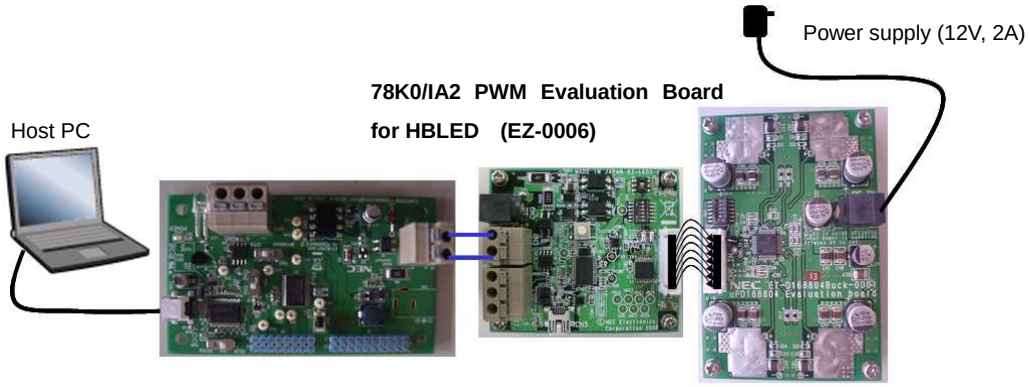
1. Overview

78K0/IA2 PWM Evaluation Board for HBLED is an evaluation kit for generating 4 channels 16bit PWM output using the 78K0/IA2 microcontroller.

This board can operate by DC5V power supply provided from AC adapter. Please prepare AC adapter by yourself. It is also possible to operate by using DC5V provided from “uPD168804 Buck converter HBLED evaluation board (EZ-0007)” to control high brightness LEDs on that board in case of using EZ-0007 connecting with this board. In this case, it is not necessary to use AC adapter.

78K0/IA2 generates 4 channels of 16bit PWM output. It can control high brightness LEDs dimming. It can also control the evaluation board operating with analog input. When connecting with a Lighting Communication Master Evaluation Board (EZ-0008), LEDs can be controlled to dim with DMX512 protocol or DALI protocol.

Figure 1. System setup example
(RUN mode / DALI protocol control/power supply from EZ-0007)



1.1 Feature

- 4 channels 16bit PWM output generated by 78K0/IA2 microcontroller
  - 5V supply voltage
- 2 kinds of control interface supported
  - DMX512 protocol communication interface
  - DALI protocol communication interface
- Programming / On-chip debug supported

1.2 Operation Mode

- PROG mode
  Flash programming through the USB interface.
- RUN mode
  Two control interfaces are offered on this board.
  - DMX512 protocol control interface
  - DALI protocol control interface
- On-chip debug mode
  On-chip debug through the USB interface.

1.3 Related product information

As for the information of related products for this board, please see NEC Electronics Web site.

URL **http://www.necel.com/micro/en/solution/lighting/index.html**

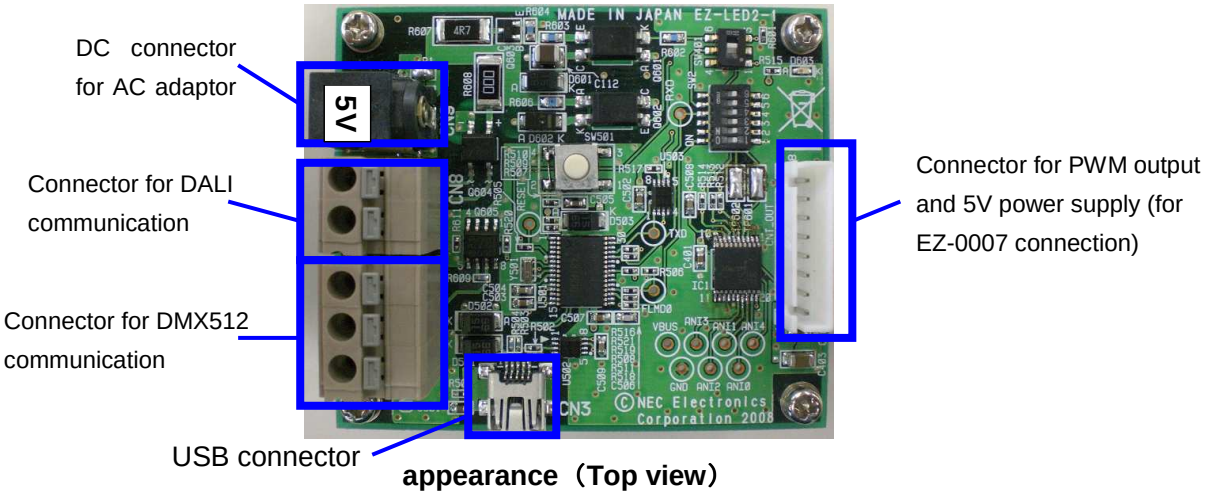
2. Specification

This chapter described the specification of 78K0/IA2 PWM Evaluation Board for HBLED

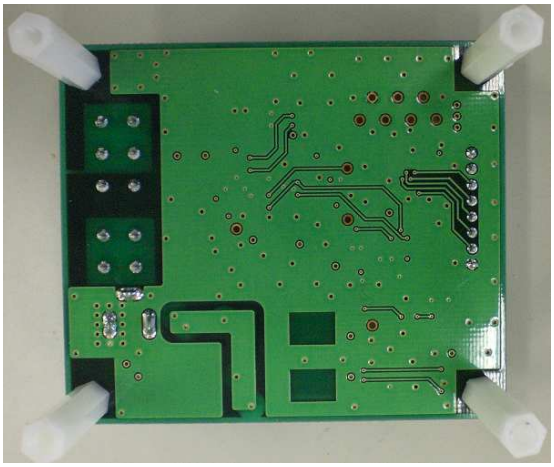
2.1 Appearance of the board

The following figure shows the appearance of 78K0/IA2 PWM Evaluation Board for HBLED.

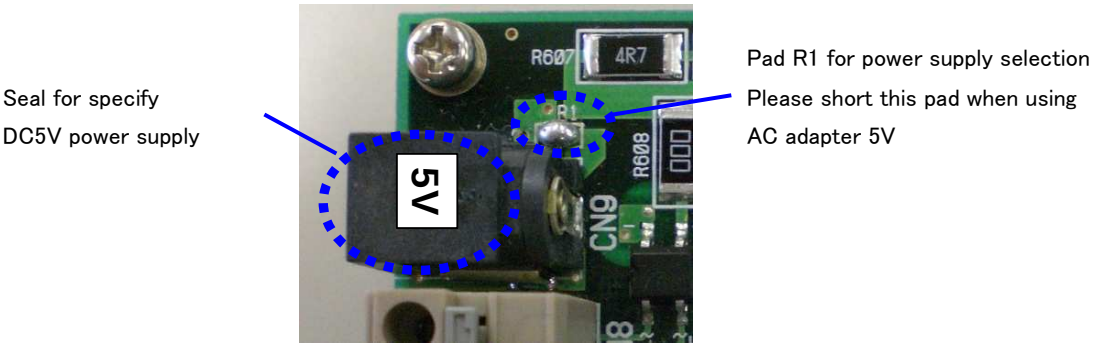
Figure 2. Appearance of 78K0/IA2 PWM Evaluation Board for HBLED.



appearance（Top view）



appearance（Bottom view）



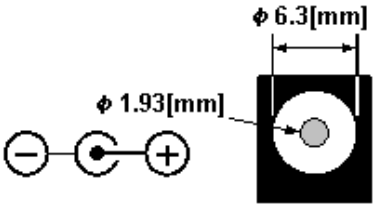
DC connector （TOP view）

Caution	
	**In case of using “uPD168804 Buck converter HBLED Evaluation board” and power of MCU board is supplied from that board, do not supply power for DC plug of MCU board.** It may cause product failure.

2.2 Detail specification

Board name : EZ-LED2-001
Power supply : 5[V] 0.45[A]
Microcontroller : 78K0/IA2 (uPD78F0754MC-CAB-AX)
DC plug : Switchcraft RAPC722 (Center pin ϕ 1.93mm, Plug ϕ 6.3mm (max))

Figure 3. Polarity and shape of DC plug



2.3 Power supply

The following AC adaptor or DC power supplier is recommended to be applied to 78K0/IA2 PWM Evaluation Board for HBLED

①DC power supplier from uPD168804 Buck converter HBLED Evaluation board(EZ-0007)
Connector: CN_OUT of 78K0/IA2 PWM Evaluation Board for HBLED (EZ-0006)

②AC Adaptor
Output voltage : 5[V]
Output current : 0.45[A]
Connector : refer to figure 3
Type : Switching regulator type with over current protect circuit
Do not use AC adapter whose output voltage is guaranteed only when rated load current flows.
Note: Pad R1 should be short when using AC adapter 5V through CN9.

③DC power supplier
Output voltage : 5[V]
Output current : over 0.45[A]
Connector : Through CN_OUT of EZ-0006 or the connector as shown in figure 3.

Warning

Use AC adapter adapted to safety standard of each county.
Using non-adopt AC adapter cause product failure, generation of heat, fire or electric shock.

Caution

In case of using "uPD168804 Buck converter HBLED Evaluation board" and power of MCU board is supplied from that board, do not supply power for DC plug of MCU board.
It may cause product failure.

See Appendix A for schematic of 78K0/IA2 PWM Evaluation Board for HBLED

2.4 Switch setting/Connector pin assign

Table1. DIP Switch SW2 setting

Bit	ON	OFF
1	RUN mode for 78K0/IA2	PROG/OCD mode for 78K0/IA2
2	Not specified.	
3	Enable communication between 78K0/IA2 and USB microcontroller	Reserve for USB microcontroller firmware updating without a USB cable.
4	Enable communication between 78K0/IA2 and USB microcontroller	Reserve for USB microcontroller firmware updating without a USB cable.
5	Connect TxD6 pin of 78K0/IA2 to lighting communication circuit DMX512 or DALI	Disconnect TxD6 pin of 78K0/IA2 and communication circuit. User can connect his own communication circuit to 78K0/IA2 through TP601.
6	Connect RxD6 pin of 78K0/IA2 to lighting communication circuit DMX512 or DALI	Disconnect RxD6 pin of 78K0/IA2 and communication circuit. User can connect his own communication circuit to 78K0/IA2 through TP602.

Table 2. Other Switches setting

No.	Description
SW501	RESET button
SW401	Communication interface selection switch. Setting to 1,4 side :DMX512 interface Setting to 3,6 side :DALI interface

Table3. Pin assignment of CN_OUT

Pin	MCU pins	Function	Pin name on driver board
1	VDD	5V DC power supply from EZ-0007	5V_TP
2	ANI5/P25/CMP1+	ENABLE signal output	EN
3	P31/TOX00/INTP2/TOOLC	PWM output for CH0 dimming	CH0
4	P32/TOX01/INTP3/TOOLD	PWM output for CH1 dimming	CH1
5	P33/TOX10	PWM output for CH2 dimming	CH2
6	P34/TOX11	PWM output for CH3 dimming	CH3
7	P00/TI000/INTP0	Thermal Shutdown detect signal input	SH
8	VSS	GND	GND

Note. To get 5V DC power supply from uPD168804 Buck converter HBLED Evaluation board, connect Pin 1 of CN_OUT to the 5V_TP of uPD168804 Buck converter HBLED Evaluation board.

3. Operation

3.1 Preparation

3.1.1 Driver installation

Install the driver when connecting the 78K0/IA2 PWM Evaluation Board (EZ-0006) to the PC by using a USB cable for the first time.

① Download driver from following URL.
URL **http://www.necel.com/micro/en/solution/lighting/download.html**

② When connecting this board to PC by using USB cable, ”Found New Hardware Wizard” dialog box is displayed.
Select ”Yes, now and every time I connect a device”, and click [Next].

③ Select ”Install from a list or specific location (Advanced)”, and clock [Next].

④ Select “Include this location in the search” and then click [Browse]
Specify the folder to which download files are saved, and click [Next]

⑤ Installation starts
Click [Continue Anyway] while “Hardware Installation” dialog is displayed.

⑥ Click [Finish]. Installation is complete.

3.1.2 Programmer installation

Please install the programmer for 78K0/IA2 flash programming.

① Download programming software “WriteEZ3” and related parameter file from following URL.
URL **http://www.necel.com/micro/en/solution/lighting/download.html**

② Decompress the downloaded pack.

3.1.3 On-chip debugger and compiler installation

Please install On-chip debugger and compiler if On-chip debug mode of this board is required to be used.

① Download integrated debugger “ID78K0-QB”, NEC Electronics development tools “PM+”,”RA78K0”, “CC78K0”, and device file for the target device 78K0/IA2 microcontroller.
URL **http://www.necel.com/micro/en/solution/lighting/download.html**

② Install “RA78K0”. Project manager “PM+” will be installed automatically.

③ Install “CC78K0”

④ Install device file

⑤ Install “ID78K0-QB”

3.1.4 Communication GUI installation

To control the LED by DMX512 or DALI protocol, NEC Electronics offers Lighting communication board (EZ-0008) and GUI for easy evaluation.

About the lighting communication board (EZ-0008), please refer to Lighting Communication Master Evaluation Board (EZ-0008) Quick Start Guide (ZUD-CE-09-0018).

① Download DMX512 or DALI GUI from the following URL.
URL **http://www.necel.com/micro/en/solution/lighting/download.html**

② Install the GUI for the communication protocol which is supposed to be used.
For detail, please refer following User's Manual
DALI master controller GUI User's Manual (U19607)
DMX512 master controller GUI User's Manual (U19596)

3.1.5 Sample programs

NEC Electronics offers several sample programs for LED control of 78K0/IA2 PWM Evaluation Board for HBLED. Download the sample programs from the following URL for reference.

URL **http://www.necel.com/micro/en/solution/lighting/download.html**

3.2 PROG mode

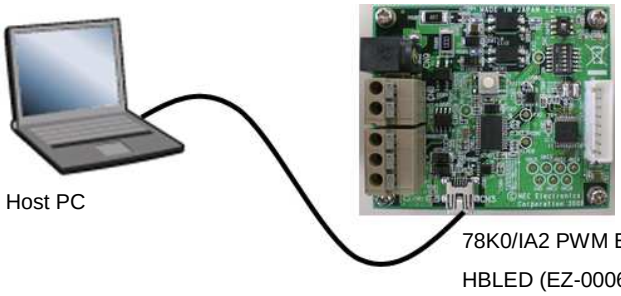
3.2.1 Start Programming

① Set SW2.1 of this board to “OFF”.

② Insert 5V power supply through DC plug or connector “CN_OUT”.

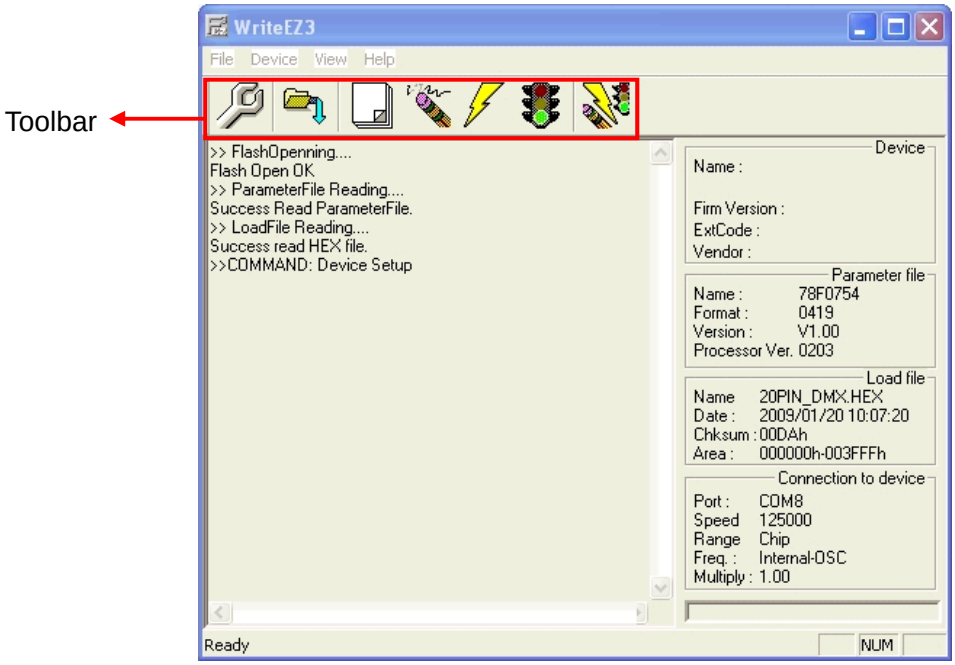
③ Connect this board to PC by using USB cable.

Figure 4. Connection when programming to 78K0/IA2



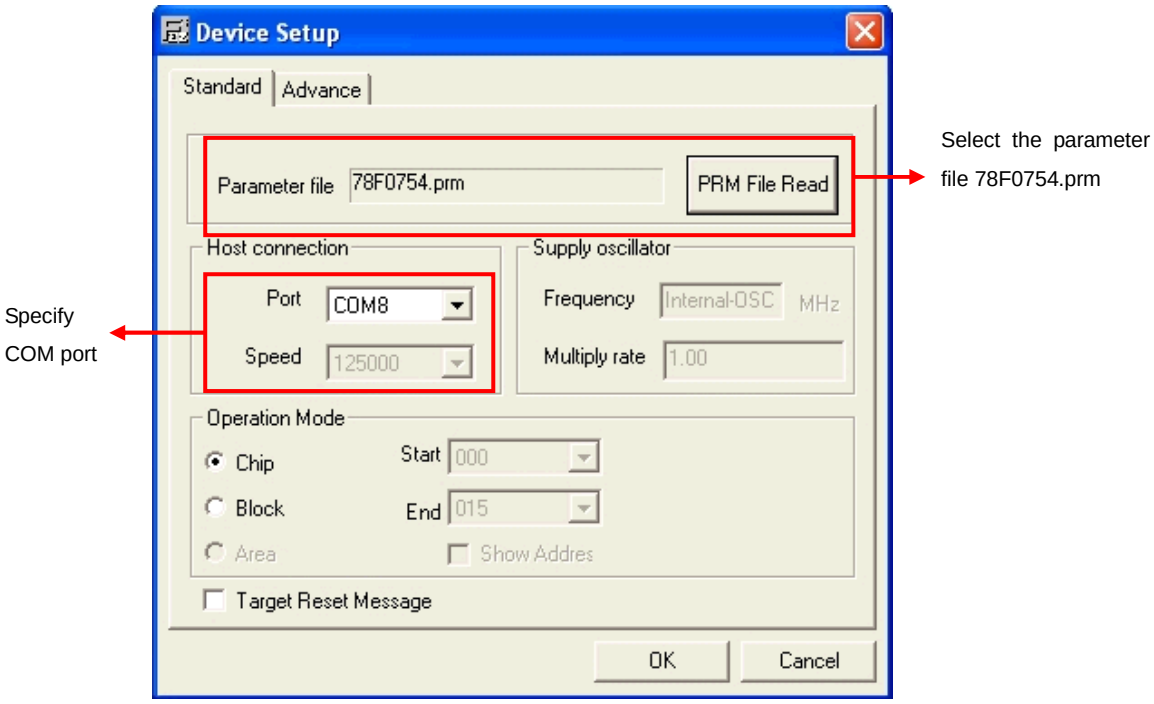
④ Start up “WriteEZ3”

Figure 5. Main window of WriteEZ3



⑤ Click [Setup] to open the device setup dialog box.
Select parameter file 78F0754.prm
Specify the COM port for communication between host PC and this board.

Figure 6. Device Setup Dialog box



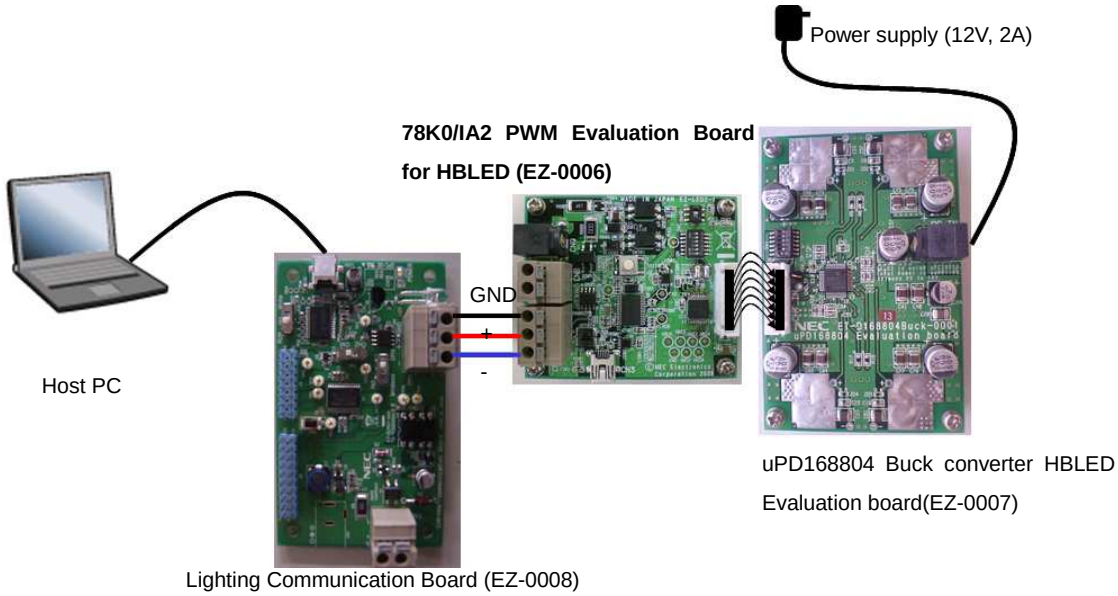
⑥ Click [Load] to select the hex file which is expected to be programmed.
⑦ Click [Autoprocedure] to do flash programming.
⑧ Close “WriteEZ3”.
⑨ Disconnect the power supply and USB cable.

3.3 Run mode

3.3.1 Generate PWM output to control LEDs by DMX512 protocol

① Programming the Hex file supporting DMX512 protocol.
Please refer **3.2 Programming mode** for programming.
② Confirm bit 1, 5 and 6 of SW2 are set to “ON”, and SW401 is set to “1,4” side.
③ Connect this board to uPD168804 Buck converter HBLED Evaluation board (EZ-0007) through CN_OUT.
④ Connect this board and Lighting communication master board (EZ-0008) or your own master for DMX512 through DMX512 interface CN7

Figure 7. Example of connection for DMX512 protocol control (RUN mode)



⑤ Provide DC 12V to uPD168804 Buck converter HBLED Evaluation board (EZ-0007)
⑥ Send DMX512 codes to slave by DMX512 Master Controller GUI or your own software.
⑦ Disconnect the DC power from DC plug when finished evaluation.
⑧ Disconnect this board and communication master board.
⑨ Disconnect this board and uPD168804 Buck converter HBLED Evaluation board.

Note1: To find details of DMX512 Master Controller GUI, please refer to User’s Manual of DMX512 Master Controller GUI (U19596).
Note2: To find details of uPD168804 Buck converter HBLED Evaluation board, please refer to User’s Manual of uPD168804 Buck converter HBLED Evaluation board (RK-UD-09-0062)

Note3: In the sample hex file released on web, the DMX512 communication data is defined as following.

Table 5：DMX512 data assignment in sample program

	Control the Duty
Start Code	00h
DMX512 DATA1	White LED(CH0) brightness
DMX512 DATA2	Red LED(CH1) brightness
DMX512 DATA3	Green LED(CH2) brightness
DMX512 DATA4	Blue LED(CH3) brightness

Since this sample defined 28 dimming steps, the target step is calculated from DMX512 data as the following equation: target step = data*28/256.

Warning

Do not plug in or unplug a connector or cable with power applied to the board.
Doing so may cause product failure, generation of heat, fire or rupture.

Caution

In case of using “uPD168804 Buck converter HBLED Evaluation board” and power of MCU board is supplied from that board, do not supply power for DC plug of MCU board.
It may cause product failure.

Confirm all DIP switch on “uPD168804 Buck converter HBLED Evaluation board” is “OFF” before connecting power supply and cables.
In case DIP switch is “ON”, LED will turn on when power is supplied, and it may cause product failure when MCU board is connected.

3.3.2 Generate PWM output to control LEDs by DALI protocol

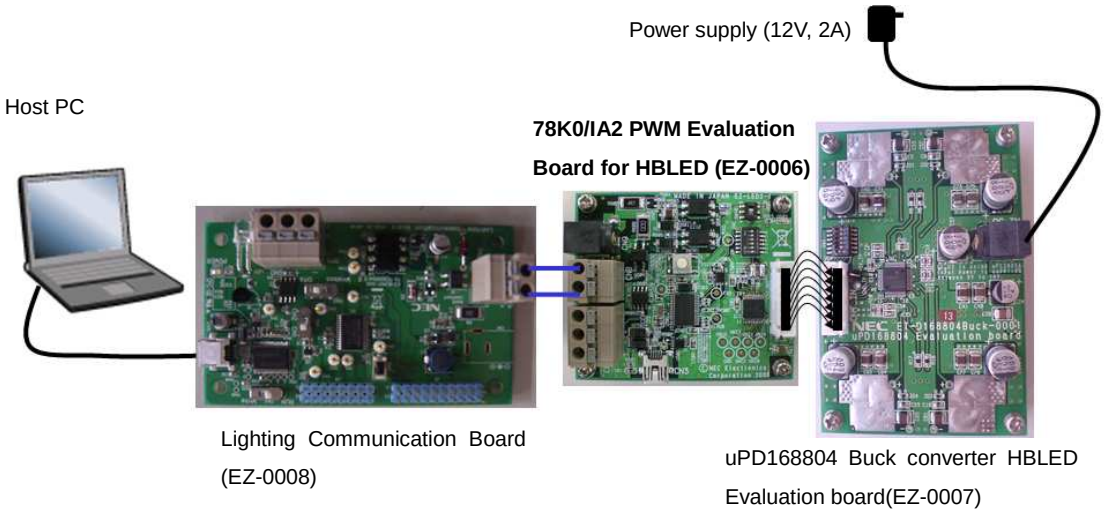
① Programming the Hex file supporting DALI protocol.
Please refer **3.2 Programming mode** for programming.

② Confirm bit 1, 5 and 6 of SW2 are set to “ON”, and SW401 is set to the ”3,6” side.

③ Connect this board to uPD168804 Buck converter HBLED Evaluation board (EZ-0007) through CN_OUT.

④ Connect this board to Lighting communication master board (EZ-0008) or your own master for DALI through DALI interface CN8.

Figure 8. Example of connection for DALI protocol control (RUN mode)



⑤ Provide DC 12V to uPD168804 Buck converter HBLED Evaluation board (EZ-0007)

⑥ Send DALI codes to slaves by DALI Master Controller GUI or your own software.

⑦ Disconnect the DC power from DC plug when finished evaluation.

⑧ Disconnect this board and the master board.

⑨ Disconnect this board and uPD168804 Buck converter HBLED Evaluation board.

Note1: To find details of GUI, please refer to the User’s Manual of DALI Master Controller GUI (U19607).

Note2: To find details of uPD168804 Buck converter HBLED Evaluation board, please refer to User’s Manual of uPD168804 Buck converter HBLED Evaluation board (RK-UD-09-0062)

Warning	
	Do not plug in or unplug a connector or cable with power applied to the board. Doing so may cause product failure, generation of heat, fire or rupture.

Caution	
	**In case of using “uPD168804 Buck converter HBLED Evaluation board” and power of MCU board is supplied from that board, do not supply power for DC plug of MCU board.** It may cause product failure.
	**Confirm all DIP switch on “uPD168804 Buck converter HBLED Evaluation board” is “OFF” before connecting power supply and cables.** In case DIP switch is “ON”, LED will turn on when power is supplied, and it may cause product failure when MCU board is connected.

3.3.3 Generate PWM output for your own evaluation

① Programming the Hex file for your own evaluation
② Confirm bit1, 5 and 6 of SW2 are set to “ON”.
③ Connect this board to your own evaluation board.
④ Provide DC 5V through CN9
⑤ Disconnect the DC power from DC plug when finished evaluation.

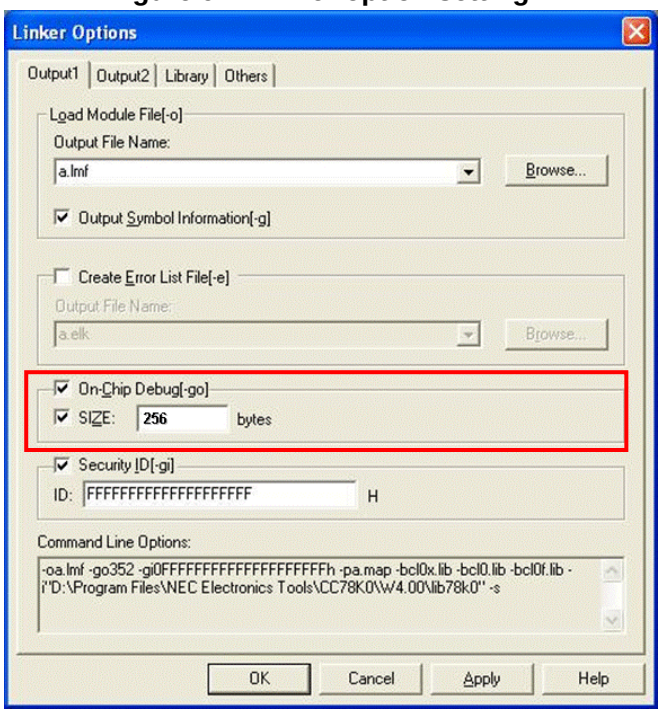
Warning	
	**Do not plug in or unplug a connector or cable with power applied to the board.** Doing so may cause product failure, generation of heat, fire or rupture.

3.4 On-chip Debug mode

① Set bit 1 of SW2 to “OFF”, and confirm bit 3 to 6 of SW2 are set to “ON”.
② Connect this board to host PC with USB cable.
③ Provide DC 5V to this board.
④ Start up debugger ID78K0-QB. For details of debugger operation, please refer to the User’s Manual of debugger.
⑤ Close ID78K0-QB when finished on-chip debug.
⑥ Disconnect the power supply
⑦ Disconnect the USB cable.
⑧ Disconnect all other cables including communication cable for DMX512 or DALI.

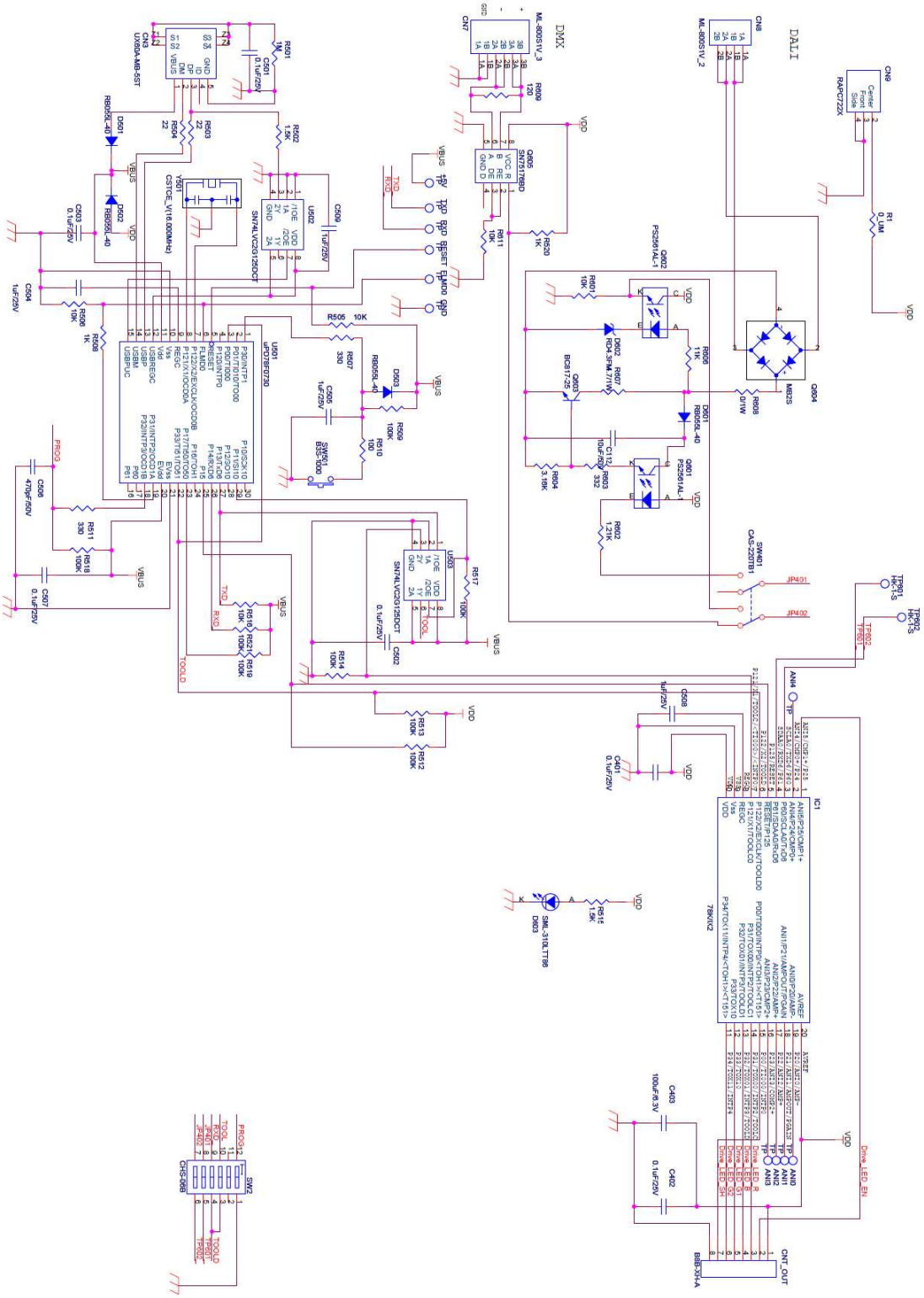
Note: To use on-chip debug function, some area of the 78K0/IB2 microcontroller must be secured. When using NEC Electronics compiler RA78K0, CC78K0, area can be secured by setting the linker option. To use the on-chip debug function, check the check box”On-chip debugger [-go]”.
If the pseudo RRM function is not expected to be used, 256 bytes should be secured.

Figure 9. Linker option setting



Warning	
	Do not plug in or unplug a connector or cable with power applied to the board. Doing so may cause product failure, generation of heat, fire or rupture.

Appendix A Schematic



Appendix B Revision History

Revision	Modified Points	Page
Rev.1.0	First edition	

For further information,
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