

MESSRS :

Instruction Manual

CUSTOMER PRODUCT NAME :

DC/DC CONVERTER UNIT
TDK-Lambda ALD-214012PJ111 ALD-414012PJ126
PRODUCT NAME: ALD-514012PJ134



TDK-Lambda Corporation

PREPARED BY	APPROVED BY	AUTHORIZED BY
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Precautionary Notes Regarding the Use of This Converter

When using this product, give due consideration to the precautionary notes described below and ensure a safe design. Inappropriate use may result in electric shock, injury or fire.

Caution

- This product is designed for driving LED backlight systems.
Do not use it with any other load.
- Store this product under the conditions defined in the specification document.
- Do not store this product in an environment where dust, dirt or corrosive gas(salt,acid,base, etc.) is present.
- This product is designed for use with general electronic equipment.
If it is to be used with medical equipment that directly affects human life or for the control of transportation equipment to which passengers entrust their lives, provide thorough fail-safe measures.
- Avoid using this product under high temperatures or high humidity or in an environment in which dust, dirt or any corrosive gas (salt,acid,base, etc.) is present.
Also, be careful not to allow the formation of dew condensation. It may result in damage or electric shock.
- If the product does not have a built-in protective circuit (circuit breaker, fuse, etc.), it is recommended that a fuse be used at the input stage to prevent the occurrence of smoke or fire in the event of a malfunction.
Even when the product has a built-in protective circuit (circuit breaker, fuse, etc.), the circuit may not function properly due to inappropriate operating conditions or power-supply capacity.
It is recommended that an appropriate protective circuit (circuit breaker, fuse, etc.) be provided separately from the built-in circuit.
- Use the product only within the specified input voltage, output voltage, and operating temperature ranges.
Exceeding these values may result in damage, etc.
- Provide a measure for the prevention of surge voltage due to lightning, etc.
Abnormal voltage may result in damage, etc.
- This product is not designed to provide resistance to radiation.
- Ripples could be superimposed on the voltage and the current in the input source connected to the inverter, depending on the impedance in the input source, wiring, etc.
When you select an input source, please check waveforms, etc on the final set.
- This product doesn't have the input overvoltage protection circuit. If there is a possibility that the surge voltage is impressed to the input, please do the surge prevention measures.
- Please do not remodel and do not process it. Our company doesn't assume the responsibility of those things.
- Please attentionnote the safe design enough. Especially, do not cause the troubles such as the accident causing injury or deaths and fire accidents.

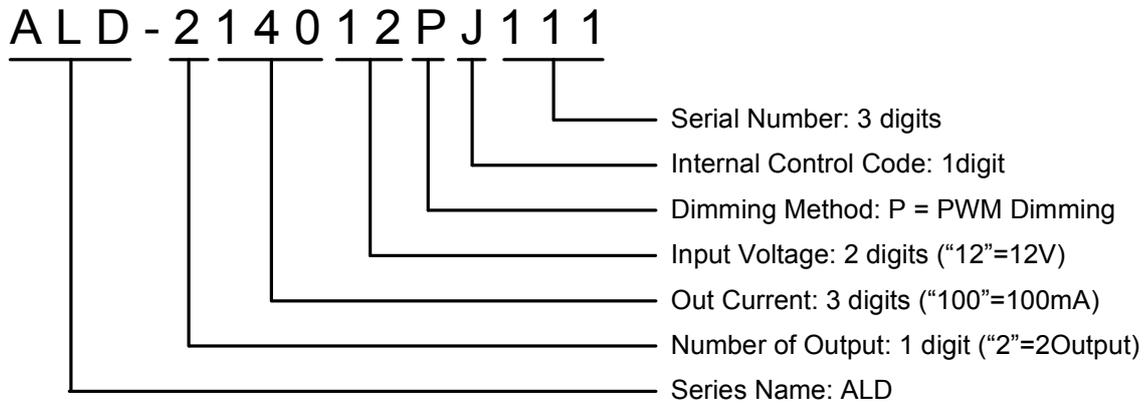
Handling Precautions

- Do not stack multiple products on top of one another.
- Do not allow the product to come in contact with tools, etc.
- Do not apply excessive stress during installation.
It may cause chipping and cracking, resulting in damage, etc.
- Please do not use the product, if it has been dropped because there is the possibility of component damage.



DC-DC Converter Unit ALD Series: Instruction Manual

1 Product Name



2 Product Summary

* The ALD Series Lineup is as follows:

Item Name	# of Strings	Input Voltage (Vdc)	Output Current (mA)	Burst Freq. (Hz)	Dimming		Vopen max (V)	Dimensions
					Analog DC(V)	PWM DC(V)		
ALD-214012PJ111	2	10.8~13.2	140	200	2.5~0	2.5~0	44	85.0(typ.)x21.5(typ.)x5.2(max)
ALD-414012PJ126	4	10.8~13.2	140	200	2.5~0	2.5~0	44	100.0(typ.)x50.0(typ.)x5.2(max)
ALD-514012PJ134	5	10.8~13.2	140	200	2.5~0	2.5~0	44	100.0(typ.)x50.0(typ.)x5.2(max)



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3 Terminal Connection

* Please be careful when connecting the input terminal. The converter may be damaged if there is a mistake in the terminal connection or polarity.

The connector used for each product is different so make sure that you use only the connector indicated in the Product Specifications.

Please refer to Table 3-1 which indicates the connector to be used with each product.

Table 3-1

Product Name	Input Connector	Corresponding connector	Vendor	Output Connector	Corresponding connector	vendor
ALD-214012PJ111	SM08B-SRSS-TB	SHR-08V-S-B	JST	SM06B-SRSS-TB	SHR-06V-S-B	JST
ALD-414012PJ126	SM14B-SRSS-TB	SHR-14V-S-B	JST	SM10B-SRSS-TB	SHR-10V-S-B	JST
ALD-514012PJ134	SM14B-SRSS-TB	SHR-14V-S-B	JST	SM10B-SRSS-TB	SHR-10V-S-B	JST

* The input connector functions are explained in Tables 3-2~3-3.

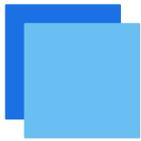
Table 3-2 ALD-214012PJ111

Pin	Symbol	Specification	Note
CN1-1 CN1-2	Vin	10.8~13.2(Vdc)	Input Voltage
CN1-3 CN1-4	GND	0(V)	GND
CN1-5	Vrmt	0~0.4(Vdc) : OFF 2.5~Vin(Vdc): ON	ON/OFF Control
CN1-6	Vbr	0~2.5(Vdc)	PWM dimming*1
	Rbr	0~50(kΩ)	
CN1-7	ADIM	0~2.5(Vdc)	Analog dimming*2
CN1-8	Vst (Output)	0(V) / 5(Vdc)	Alarm output*3

*1 Maximum brightness is Vbr=0V or Rbr=0Ω. Minimum brightness is Vbr=2.5V or Rbr=50kΩ.

*2 Maximum brightness is ADIM=0V. Minimum brightness is ADIM=2.5V.

*3 Alarm output is 0V at normal operation and 5V at abnormal operation. However, alarm output becomes unstable that Vrmt is not turning on.



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Table 3-3 ALD-414012PJ126, ALD-514012PJ134

Pin	Symbol	Specification	Note
CN1-1			
CN1-2			
CN1-3	Vin	10.8~13.2(Vdc)	Input Voltage
CN1-4			
CN1-5			
CN1-6			
CN1-7			
CN1-8	GND	0(V)	GND
CN1-9			
CN1-10			
CN1-11	Vrmt	0~0.4(Vdc) : OFF 2.5~Vin(Vdc): ON	ON/OFF Control
CN1-12	Vbr	0~2.5(Vdc)	PWM dimming*1
	Rbr	0~50(kΩ)	
CN1-13	ADIM	0~2.5(Vdc)	Analog dimming*2
CN1-14	Vst (Output)	0(V) / 5(Vdc)	Alarm output*3

*1 Maximum brightness is Vbr=0V or Rbr=0Ω. Minimum brightness is Vbr=2.5V or Rbr=50kΩ.

*2 Maximum brightness is ADIM=0V. Minimum brightness is ADIM=2.5V.

*3 Alarm output is 0V at normal operation and 5V at abnormal operation. However, alarm output becomes unstable that Vrmt is not turning on.

* The output connector functions are explained in Tables 3-4~3-6.

Table 3-4 ALD-214012PJ111

Pin	Symbol	Note
CN3-1	LED_C2	line2-cathode side
CN3-2	LED_A2	line2-anode side
CN3-3	LED_A1	line1-anode side
CN3-4	LED_C1	line1-cathode side
CN3-5	N.C.	Not connected
CN3-6	N.A.	Tie to GND internally

Table 3-5 ALD-414012PJ126

Pin	Symbol	Note
CN3-1	LED_C4	line4-cathode side
CN3-2	LED_A4	line4-anode side
CN3-3	LED_A3	line3-anode side
CN3-4	LED_C3	line3-cathode side
CN3-5	LED_C2	line2-cathode side
CN3-6	LED_A2	line2-anode side
CN3-7	LED_A1	line1-anode side
CN3-8	LED_C1	line1-cathode side
CN3-9	N.C.	Not Connected
CN3-10	N.C.	Not Connected

Table 3-6 ALD-514012PJ134

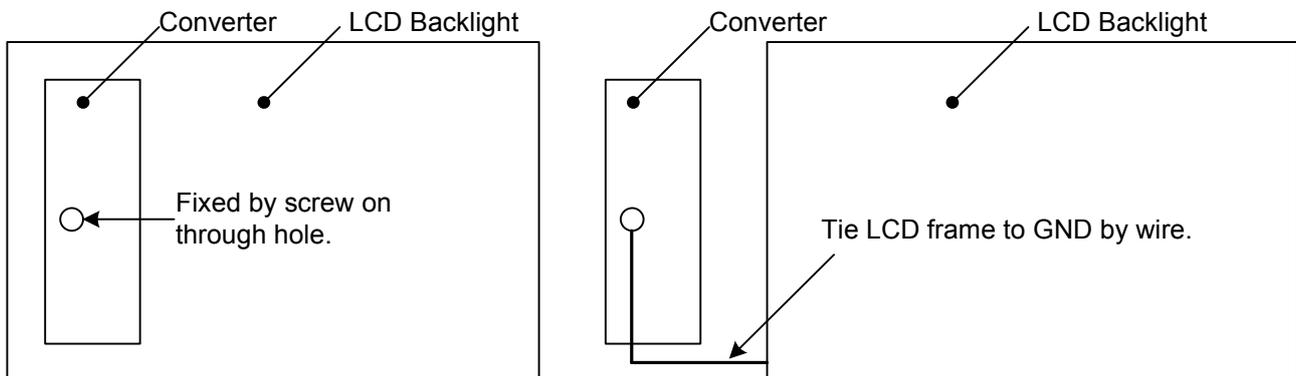
Pin	Symbol	Note
CN3-1	LED_C5	line5-cathode side
CN3-2	LED_A5	line5-anode side
CN3-3	LED_A4	line4-anode side
CN3-4	LED_C4	line4-cathode side
CN3-5	LED_C3	line3-cathode side
CN3-6	LED_A3	line3-anode side
CN3-7	LED_A2	line2-anode side
CN3-8	LED_C2	line2-cathode side
CN3-9	LED_C1	line1-cathode side
CN3-10	LED_A1	line1-anode side



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- * Vbr and ADIM terminal has a low internal impedance setting.
If you apply voltage to the Vbr terminal, we recommend a voltage follower connection or a low output impedance connection.
When you have no choice but to connect a high impedance circuit to Vbr terminal, please consider the equivalent circuit described in Internal circuit of Product Drawing.
- * Vst terminal is alarm output terminal. Vst outputs around 0V at steady state, around 5V at open LED condition.
When using the alarm output signal of the converter, we recommend high input impedance device like a comparator input or a logic input. Please consider the equivalent circuit described in Internal circuit of Product Drawing.
- * We recommend that the converter GND terminal and LCD backlight frame connected to each other. (Fig. 3-1)
When operating LCD backlight at floating connection, converter might be damaged due to application of overvoltage from LED to converter due to contact discharge to the LCD backlight.
If the converter GND fixing terminal cannot be connected directly to the LCD backlight panel, please connect from the converter GND fixing terminal to the LCD backlight frame in some way.

Fig. 3-1





4 Noise Reduction

* Converter noise generation summary

- (1) Ripple noise between input terminals
- (2) Switching noise by main switch
- (3) Induction noise by inductor leakage flux

4-1 Ripple Noise between Input Terminals

* The Input terminal of the ALD series has the following reference circuit Figures 4-1~4-3.

Fig. 4-1 ALD-214012PJ111

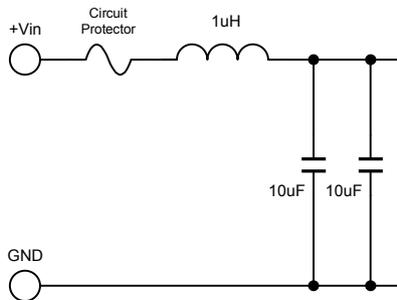


Fig. 4-2 ALD-414012PJ126

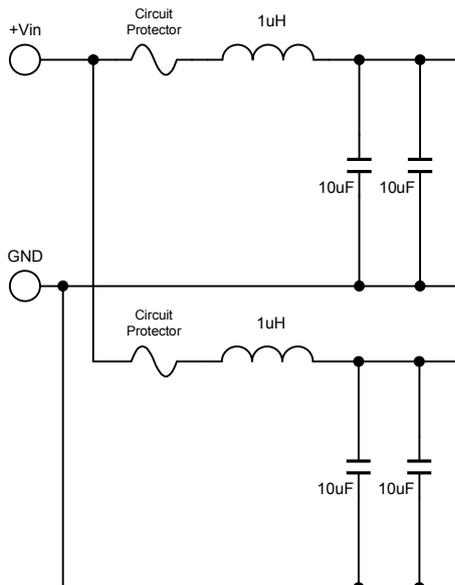
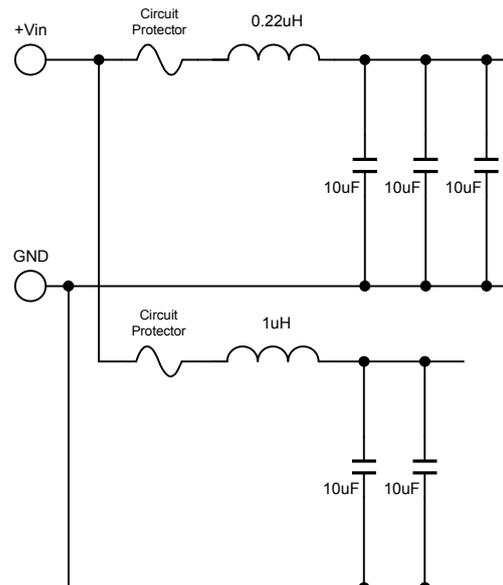
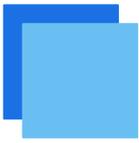


Fig. 4-3 ALD-514012PJ134





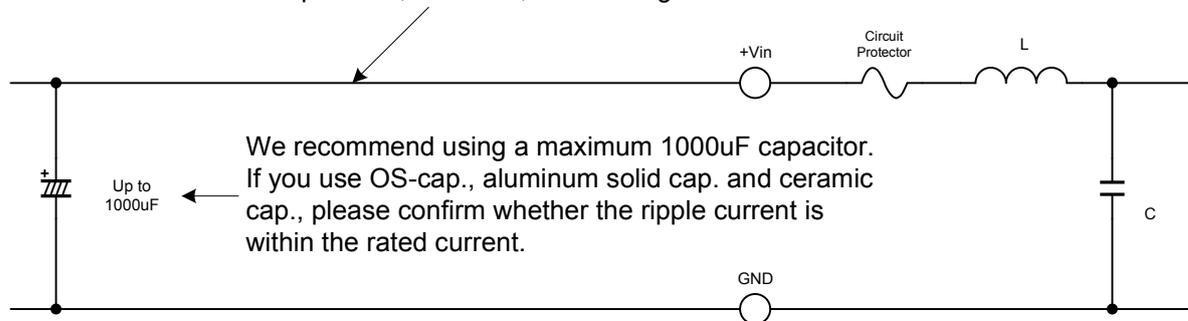
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* π -type low pass filter is available by attaching an external capacitor to the input terminal.
This filter is effective against ripple voltage and current at the input terminal.
And this filter is not susceptible to ESR and capacitance because an inductor is on the input line.

We evaluate ripple voltage and current as follows:
We attached a Nippon Chemicon type LXZ35V-1000 μ F(ϕ 12.5,L=20mm) 15cm from the converter.

The ripple voltage and current is determined by external capacitance, ESR, wire length and wiring impedance.
Please confirm ripple voltage and ripple peak current is within the value described in the Product Drawing before using.

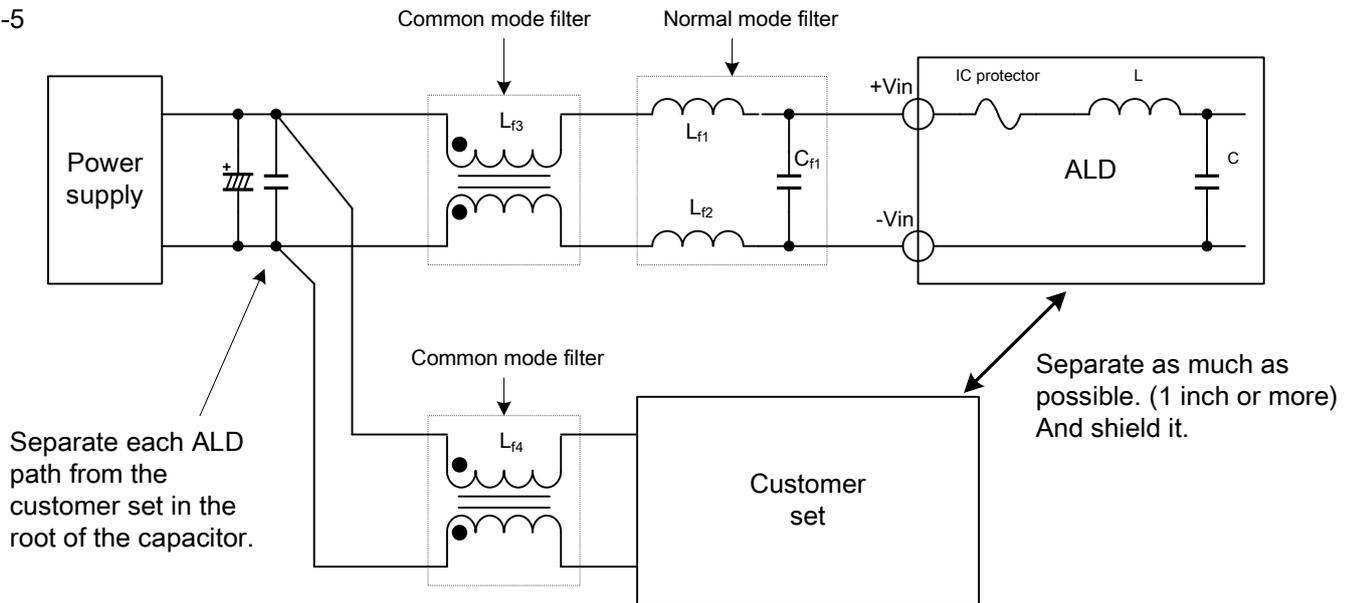
Fig. 4-4 As much as possible, use thick, short wiring



4-2 Switching Noise by Main Switch

- * The ALD series adopts the boost up chopper topology.
The switching frequency is between 500kHz and 800kHz. It is different depending on the model. The internal burst dimming frequency is about 200Hz. Noise may appear at basic frequency and odd number times of frequency.
Please confirm that the final set is not affected by this noise.
- * If the conduction noise level becomes a problem, please insert the low-pass filter, the normal mode filter, and the common mode filter of the multistage configuration in the input side according to the kind of the noise, and please use the clamping filter for the I/O cable to decrease the line noise in the power supply, as shown in Figure 4-5.
- * If the radiation noise level becomes a problem, please shield or separate the distance from electrical loop with main MOSFET, diode, and capacitor.

Fig. 4-5



* Please measure the noise as follows,

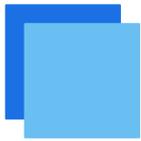
1. Measure it directly without GND side clip, in order to minimize the loop of signal - GND. However, there is a possibility that the noise gets on according to the measuring method.
2. Measure it with the following cables,
JEITA(Japan Electronics and Information Technology Industries Association), RC9141, 7.13 Fig.C
<http://www.jeita.or.jp/english/>

We uses the measuring method of 2.

4-3 Induction Noise by Inductor Leakage Flux

* In the ALD series, the choke inductor is the component that generates leakage flux. The inductor may affect the high impedance line of near field because of the huge leakage flux. Please be careful do not place signal path near field of inductor.

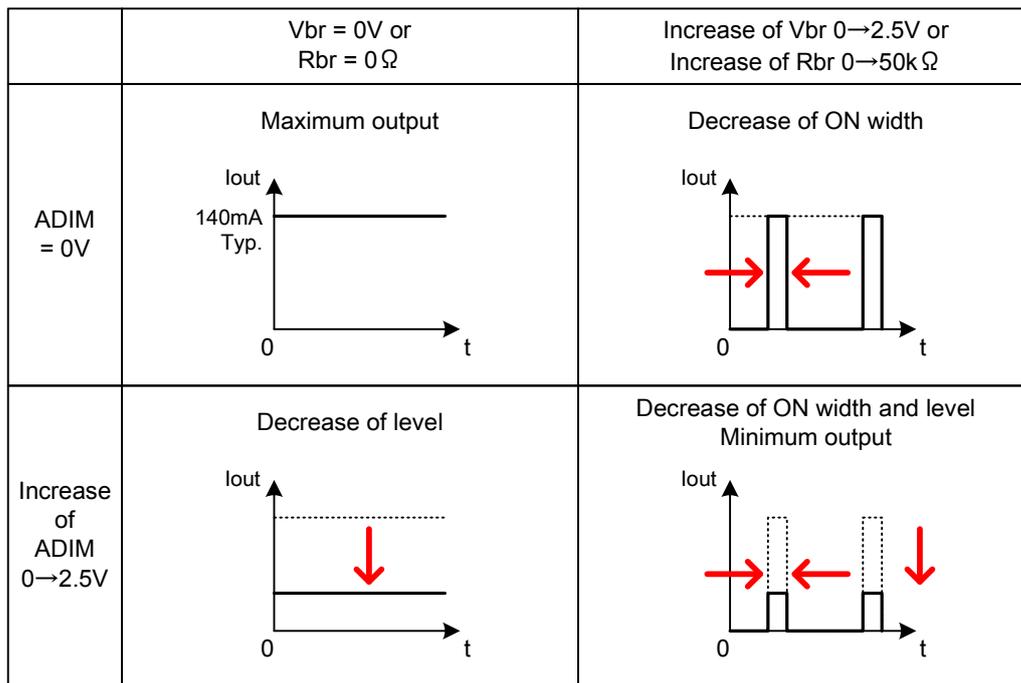
And if you shield leakage flux by high permeability material at close range of inductor top, eddy current losses by leakage flux occurs. As a result, it reduces circuit efficiency and causes unexpected heat up. Please be sure to keep enough space between shield materials and the inductor.



5 Dimming Function

- * The ALD series is able to the PWM dimming by the Vbr/Rbr terminal and the analog (current) dimming by the ADIM terminal.
- * It is possible to concurrent use of the Vbr/Rbr terminal and ADIM terminal. Figure 5-1 shows the output current images for concurrent use.

Fig. 5-1 Images of the output current signal at Vbr/Rbr/ADIM dimming.



* Next, curve of dimming characteristics is shown as follows.

5-1 ALD-214012PJ111

Fig. 5-2 PWM dimming characteristics (Vbr vs Iout)

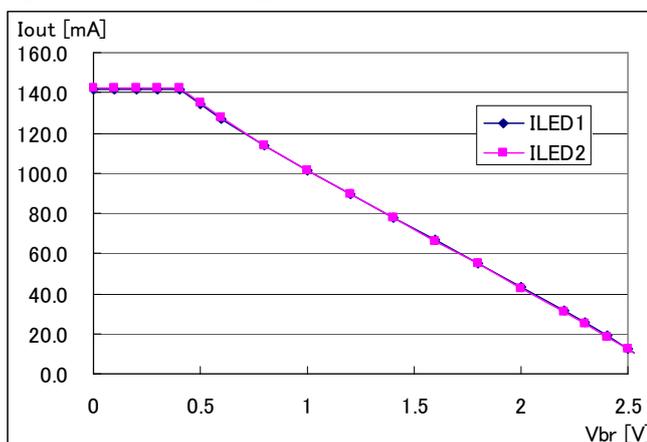
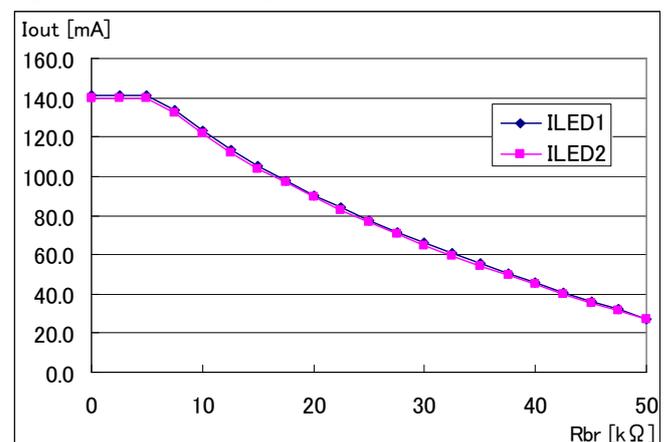


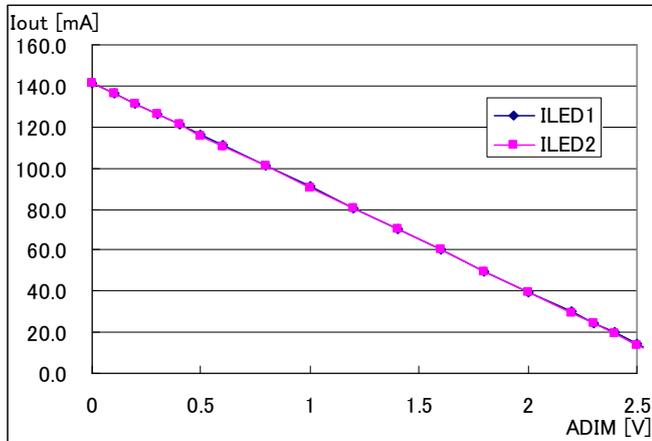
Fig. 5-3 PWM dimming characteristics (Rbr vs Iout)





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Fig. 5-4 Analog (current) dimming characteristics (ADIM vs Iout)



5-2 ALD-414012PJ126

Fig. 5-5 PWM dimming characteristics (Vbr vs Iout)

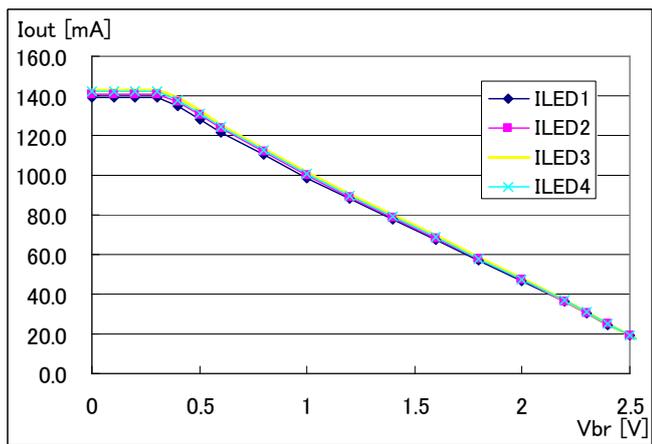


Fig. 5-6 PWM dimming characteristics (Rbr vs Iout)

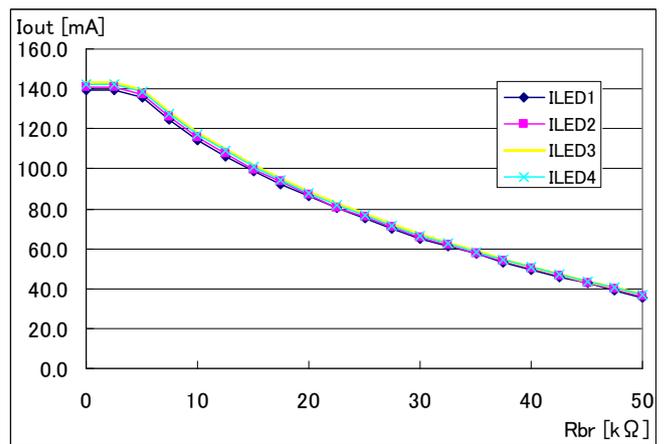
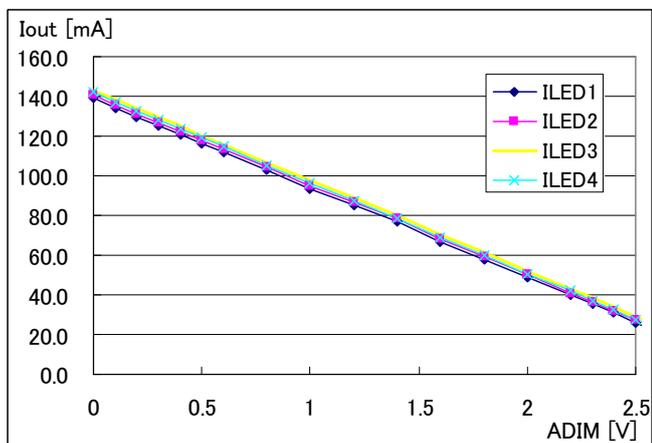


Fig. 5-7 Analog (current) dimming characteristics (ADIM vs Iout)





5-3 ALD-514012PJ134

Fig. 5-8 PWM dimming characteristics (Vbr vs Iout)

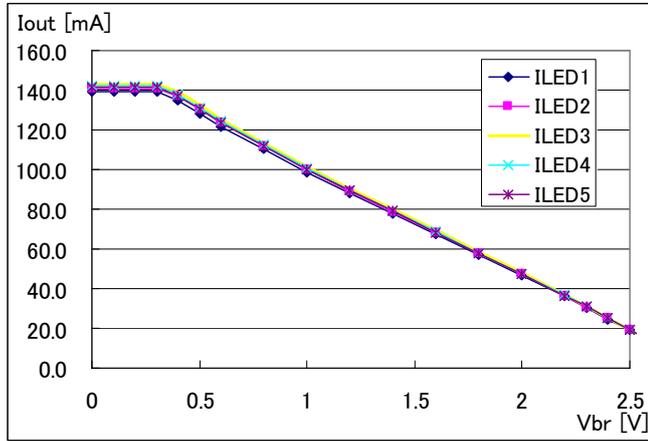


Fig. 5-9 PWM dimming characteristics (Rbr vs Iout)

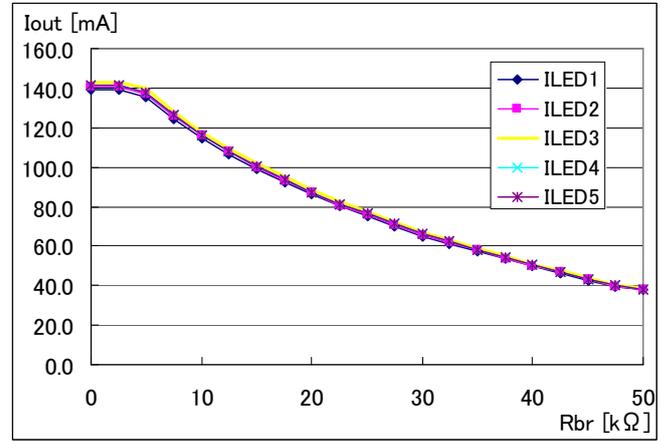
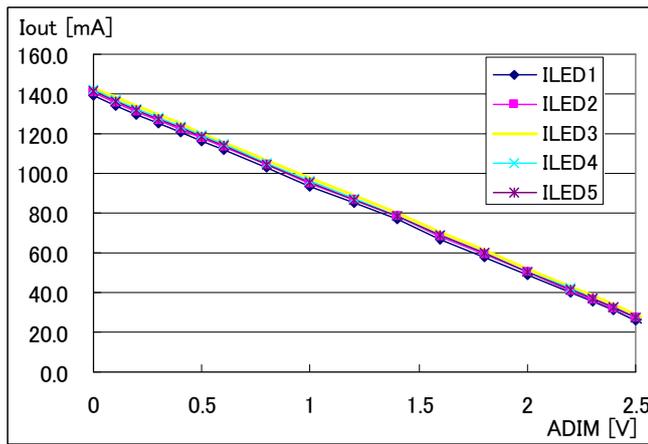


Fig. 5-10 Analog (current) dimming characteristics (ADIM vs Iout)





6 Protection function

* The ALD series has the following protection functions:

6-1 Open LED protection circuit

- * The Open LED protection circuit and the over voltage protection circuit are the same circuit. If one of the LED string is open, the opened string keeps working in an overvoltage protection condition and the other strings work normally.
- * The alarm output is Hi (around 5V) when any string is in an open condition.

6-2 Over voltage protection circuit

- * When over voltage occurs, the unit keeps on operation at the overvoltage setting level.
- * The alarm output is Hi (around 5V) when any strings work at over voltage condition.

6-3 Input over current protection circuit

- * The ALD series has Circuit Protector in the input.
- * Please ensure power supply capacity on the Product Drawing for proper operation of Circuit Protector.
- * Please confirm input current on the final products does not exceed the value on Product Drawing in any conditions. When you cannot use the power supply capacity, please prepare other external over current protection device because the circuit protector may not work properly.

6-4 Output A-C short protection circuit^{*1}

- * This ALD series^{*1} has a short protection circuit between the Anode and the Cathode output terminal.
- * However the product may be damaged at this condition. Please do not use the short-circuited product even once.

*1 Only ALD-514012PJ134



7 Alarm output function

* The ALD series has an alarm output function. The Alarm output is 0~1V at normal condition and around 5V at abnormal condition. Please confirm the following precautions:

7-1 Recommended power on/off sequence

* Turn on sequence

- 1) apply input voltage
- 2) apply Vbr and ADIM voltage (recommend low impedance output like operation amplifier output etc.)
- 3) apply remote on/off voltage (recommend high level signal at open collector or logic output)

* Please provide mask for the alarm signal at turn on when you control external product by monitoring alarm output. (Please refer to Fig.7-1:recommended sequence)

* Turn off sequence

- 1) turn off remote on/off voltage (recommend low level signal at open collector or logic output)
- 2) turn off Vbr and ADIM voltage (recommend low impedance output like operation amplifier output etc.)
- 3) turn off input voltage

* Please provide mask for the alarm signal at turn off when you control external product by monitoring alarm output. (Please refer to Fig.7-1:recommended sequence)

7-2 Turn on input voltage and remote on/off voltage simultaneously

* Turn on

* When input voltage is lower than working voltage of IC, the alarm signal may activate.

* When the rise time of input voltage is long, the alarm signal may activate.

* Please provide mask for the alarm signal at turn on when you control external product by monitoring alarm output. (Please refer to Fig.7-1:recommended sequence)

* Turn off

* When input voltage is lower than working voltage of IC, alarm signal may activate.

* When the fall time of input voltage is long, the alarm signal may activate.

* Please provide mask for the alarm signal at turn off when you control external product by monitoring alarm output. (Please refer to Fig.7-1:recommended sequence)

7-3 Turn on or turn off remote control voltage slowly

* Turn on

* When the rise time of remote on/off voltage is long, the alarm signal may activate.

We recommend slew rate apply to the remote on/off terminal is faster than 0.1V/μsec.

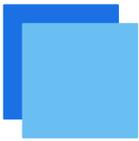
* Turn off

* When the fall time of remote on/off voltage is long, the alarm signal may activate.

We recommend that the slew rate applied to the remote on/off terminal is faster than 0.1V/μsec.

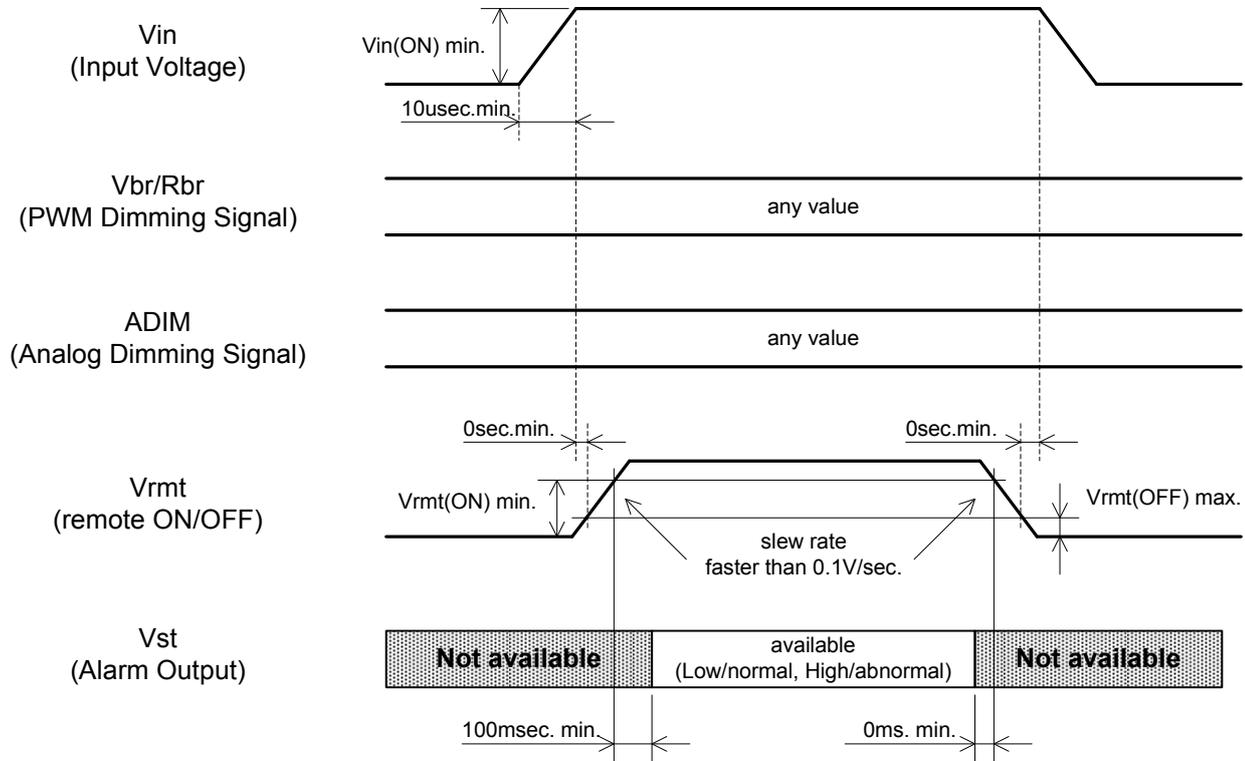
7-4 Actual alarm output operation

* Please refer to the Product Drawing “*4-4. Protection circuit operation” for each model.

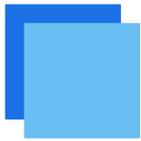


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Fig.7-1. Recommended Power On/Off Sequence



- $V_{in(ON) \text{ min.}}$: minimum of recommended working input voltage
- $V_{rmt(ON) \text{ min.}}$: minimum Vrmt on voltage
- $V_{rmt(OFF) \text{ max.}}$: maximum Vrmt off voltage



8 Recommend Connection

8-1 ALD-214012PJ111

- * Please refer to the figure 8-1 for recommend connection. In addition, refer to the Product Specification for maximum ratings of each terminal.
- * When using fixed resistor to set lout value to LED If typical value in the specification, please refer to the table 8-1 of reference resistance value.
Please confirm the lout satisfies LED specifications in worst condition including of tolerance.

Fig. 8-1 ALD-214012PJ111

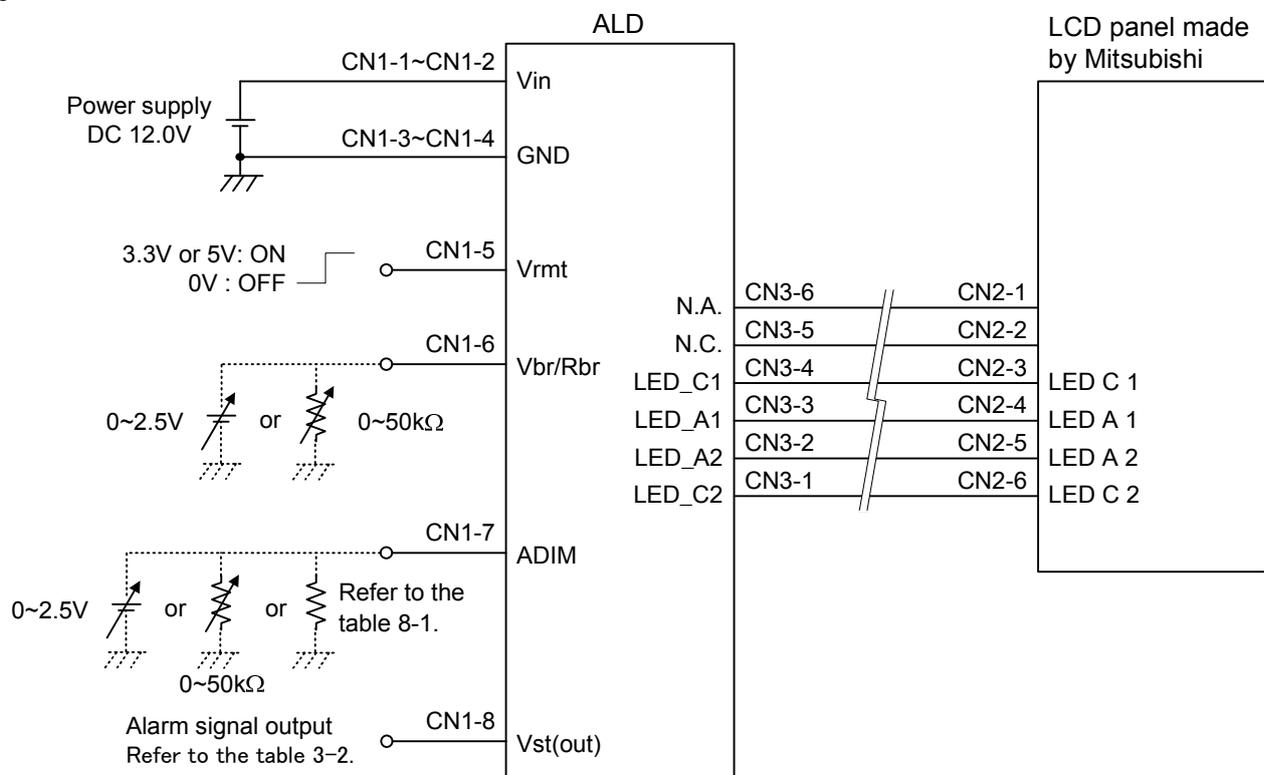


Table 8-1 ALD-214012PJ111

Value of ADIM – GND resistance [Ω]	If typ. [mA]
0	140
680	130
1.5k	120
2.7k	110
4.3k	100
6.8k	90
10k	80
18k	70
27k	65
36k	60

8-2 ALD-414012PJ126

- * Please refer to the figure 8-2 for recommend connection. In addition, refer to the Product Specification for maximum ratings of each terminal.
- * When using fixed resistor to set lout value to LED If typical value in the specification, please refer to the table 8-2 of reference resistance value.
Please confirm the lout satisfies LED specifications in worst condition including of tolerance.

Fig. 8-2 ALD-414012PJ126

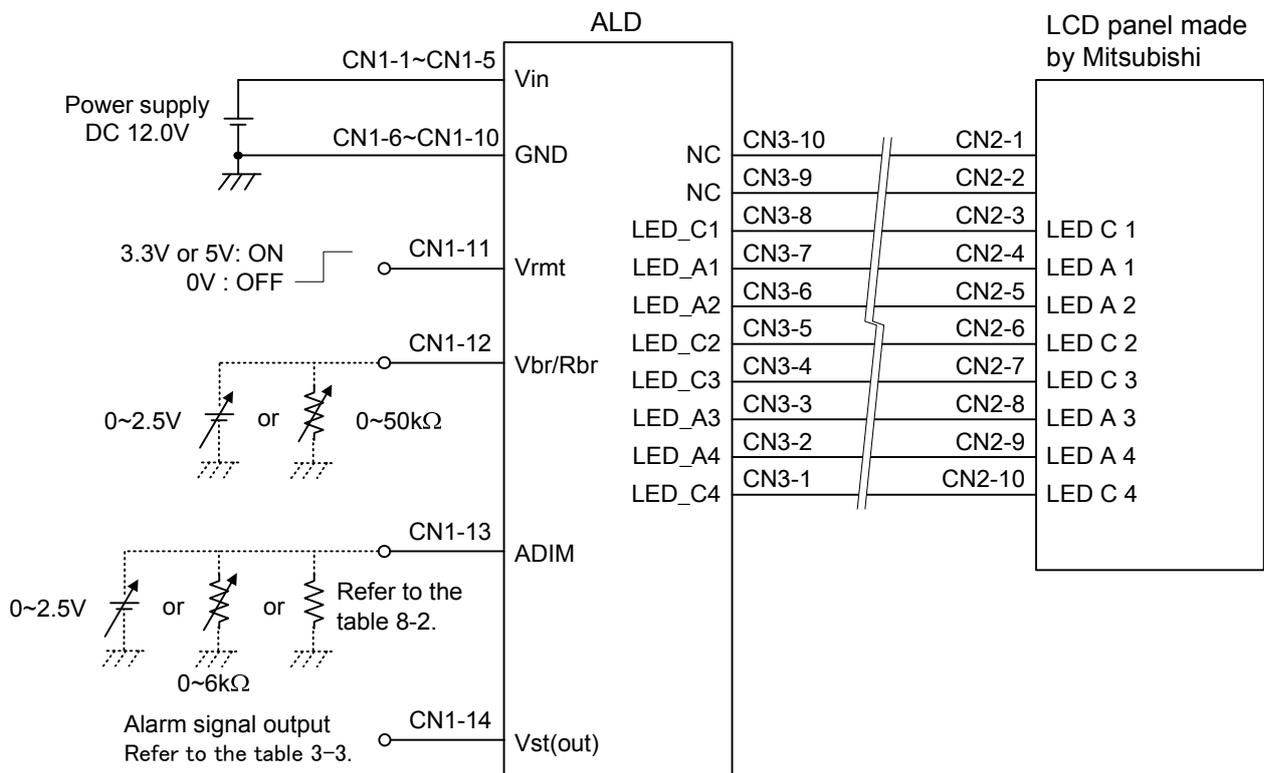


Table 8-2 ALD-414012PJ126

Value of ADIM – GND resistance [Ω]	If typ. [mA]
0	140
220	130
470	120
750	110
1.1k	100
1.5k	90
2k	80
2.4k	70
2.7k	65
3.3k	60



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- * Please refer to the figure 8-3 for recommend connection. In addition, refer to the Product Specification for maximum ratings of each terminal.
- * When using fixed resistor to set lout value to LED If typical value in the specification, please refer to the table 8-3 of reference resistance value.
Please confirm the lout satisfies LED specifications in worst condition including of tolerance.

Fig. 8-3 ALD-514012PJ134

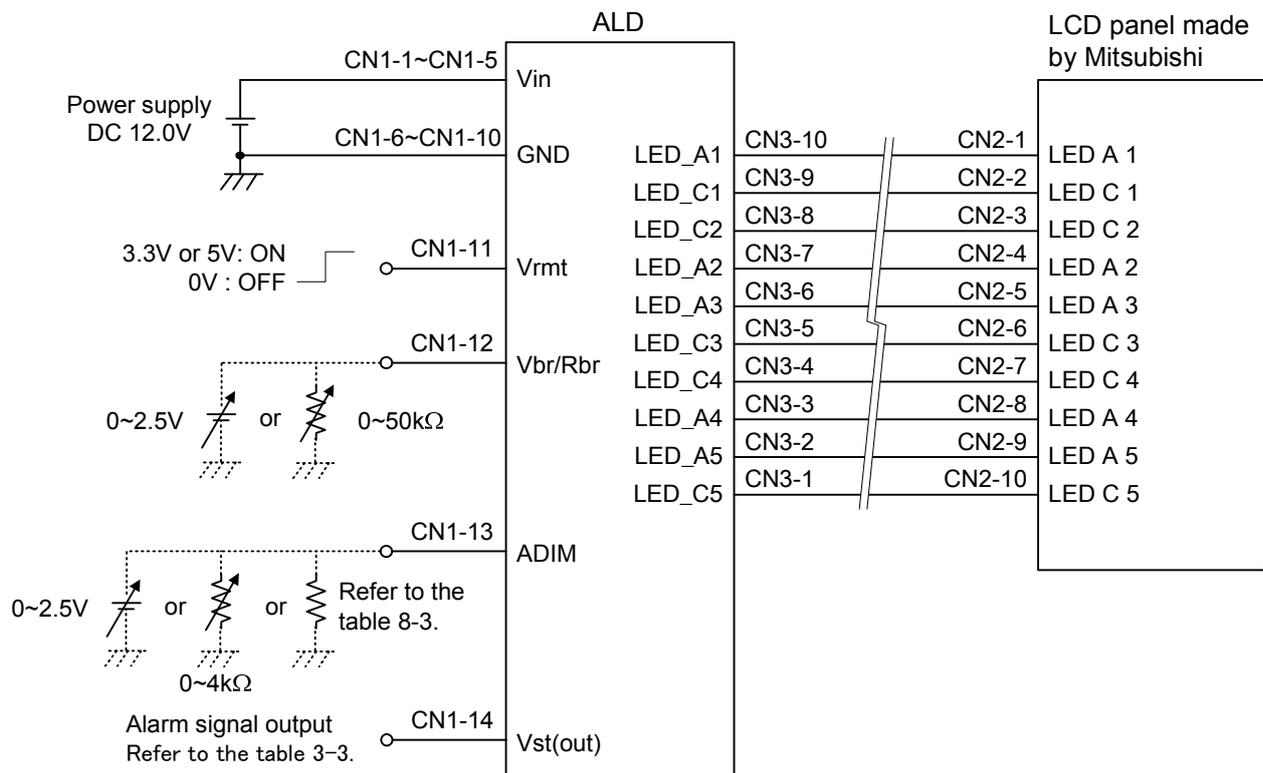


Table 8-3 ALD-514012PJ134

Value of ADIM – GND resistance [Ω]	If typ. [mA]
0	140
150	130
330	120
560	110
750	100
1.1k	90
1.5k	80
2k	70
2.4k	65
2.7k	60



9 Other Caution

- * Please avoid to control dimming by Vrmt terminal. When you want to use dimming, please use Vbr or ADIM terminal.
- * When you handle the unit, please be careful to keep unit's components from coming in contact with anything.
- * This unit does not allow hot plugging. When the unit is operating do not plug in or plug out the connector.

10 Flicker Considerations

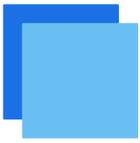
- * In PWM or Analog Dimming operation, please confirm the LCD panel operation before use. Flickering may occur due to ripple noise is on Dimming pin (Vbr / Rbr / ADIM).

11 Dimming Noise Considerations

- * In PWM Dimming operation, please confirm LCD panel operation before use. Noise may occur according to the state of the substrate installation when the PWM Dimming pin (Vbr / Rbr) is used.

12 Converter Layout Considerations

- * Please consider unit's layout to prevent long cabling. Do not use cable connector extensions.
- * In order to protect the ALD against vibration and shock, be sure to use all mounting holes when installing the ALD.
- * Please confirm the clearance between screw head and layout pattern.
- * If all the GND vias connected with the frame of LCD panel electrically, EMI may decrease.
- * Please do not put the unit on top of the back light directly without isolation.



13 Output voltage derating

13-1 ALD-214012PJ111, ALD-414012PJ126

* Please be sure to perform actual evaluation of surface temperature of the ALD mounting parts is within the value described in the Product Drawing in worst condition (input voltage, load voltage, mounting instruction, and temperature) before using it.

13-2 ALD-514012PJ134

* Please refer to Figure 13-1 for the voltage derating of the product. Please use the product in the derating curve of the Ambient (near by CN1) and the Vout condition.

* Please be sure to perform actual evaluation of surface temperature of the ALD mounting parts is within the value described in the Product Drawing in worst condition (input voltage, load voltage, mounting instruction, and temperature) before using it.

Fig.13-1 ALD-514012PJ134 output derating

