1 Connection for Standard Use

■In order to use the power supply, it is necessary to wire as shown in Fig.1.1 and external components in table1.1.

■Short the following pins to turn on the power supply.
RC ↔ RCG, +VOUT↔ +S, −VOUT↔ −S
〔Reference: 3.4 “Remote ON/OFF”
3.5 “Remote sensing”〕

■The DCS Series handles only the DC input.
Avoid applying AC input directly.
It will damage the power supply.

■Operate with the conduction cooling (e.g. heat radiation from the aluminum base plate to the attached heat sink).
〔Reference “Derating”〕

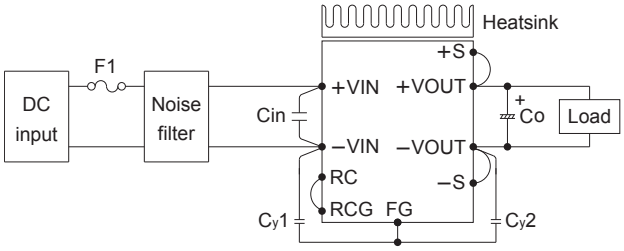

Fig.1.1 Connection for standard use

Table 1.1 External components

No.	Symbol	component	Reference
1	F1	Input fuse	2.1 (1) “External fuse”
2	C_y1	Primary decoupling capacitor	2.1 (2) “Noise filter/ Decoupling capacitor”
3	C_y2	Secondary decoupling capacitor	
4	—	Noise filter	
5	Cin	External capacitor on the input side	2.1 (3) “External capacitor on the input side”
6	Co	External capacitor on the output side	2.2 “Wiring output pin”
7	—	Heatsink	“Derating”

2 Wiring Input/Output Pin

2.1 Wiring input pin

(1) External fuse

■Fuse is not built-in on input side. In order to protect the unit, install the normal blow type fuse on input side.

■When the input voltage from a front end unit is supplied to multiple units, install the normal blow type fuse in each unit.

Table 2.1 Recommended fuse (Normal-blow type)

Model	DCS1400B
Rated current	16A

(2) Noise filter/Decoupling capacitor

■Install an external noise filter and a decoupling capacitor C_y1 and C_y2 for low line-noise and for stable operation of the power supply.

■Install a correspondence filter, if a noise standard meeting is required or if the surge voltage may be applied to the unit.

■Install a primary decoupling capacitor C_y1, with more than 470pF, near the input pins (within 50mm from the pins).

■Increasing the capacitance of the input side decoupling capacitor C_y1 to more than 18,800pF may not meet the normal specifications in the Hi-Pot test between the input and output.
In this case, connect a capacitor C_y2 with the capacity of the following formula or more between the output and FG.
DCS1400B12/24/28/36/48 C_y2 > (Total capacitance of C_y1-18,800pF) × 5
DCS1400B65 C_y2 > (Total capacitance of C_y1) × 3

■For the DCS1400B65, C_y2 should be connected regardless of the capacity of C_y1. In addition, the capacitance of C_y2 is 2,200pF or more.

(3) External capacitor on the input side

■Install an external capacitor Cin between +VIN and −VIN input pins for low line-noise and for stable operation of the power supply.
〔DCS1400B : more than 0.68μF〕

■This capacitor will experience ripple current, so please use components such as film capacitors that consider the ripple current rating.

■When the line impedance is high or the input voltage rise quickly at start-up (less than 10μs), install a capacitor Cin between +VIN and −VIN input pins (within 50mm from pins).
〔DCS1400B : more than 22μF〕

(4) Input voltage rang/Input current range

■The specification of input ripple voltage is shown as below.
〔Ripple voltage : less than 20Vp-p〕

■Make sure that the voltage fluctuation, including the ripple voltage, will not exceed the input voltage range.

■Use a front end unit with enough power, considering the start-up current Ip of this unit.

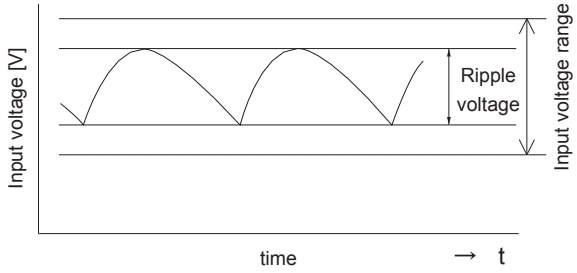

Fig.2.1 Input voltage ripple

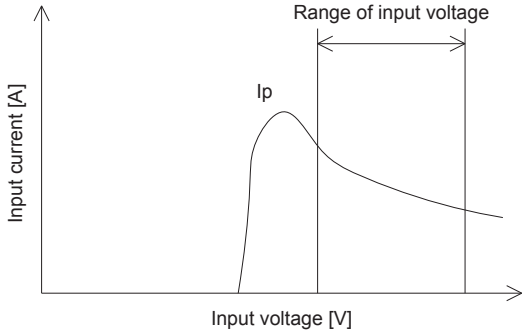

Fig.2.2 Input current characteristics

(5) Operation with AC input

■The DCS series handles only for the DC input.
A front end unit (AC/DC unit) is required when the DCS series is operated with AC input.

(6) Reverse input voltage protection

■Avoid the reverse polarity input voltage. It will break the power supply.
It is possible to protect the unit from the reverse input voltage by installing an external diode.

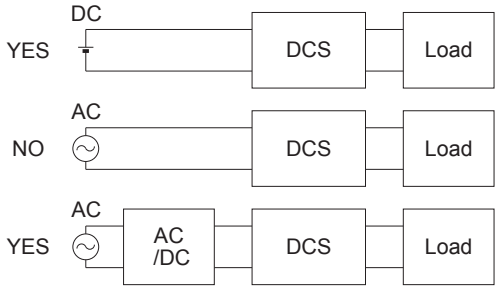

Fig.2.3 Use with AC input

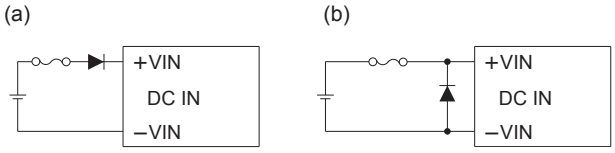

Fig.2.4 Reverse input voltage protection

2.2 Wiring output pin

■Install an external capacitor Co between +VOUT and −VOUT pins for stable operation of the power supply.
Recommended capacitance of Co is shown in Table 2.2.

■Select the high frequency type capacitor. Output ripple and start-up waveform may be influenced by ESR・ESL of the capacitor and the wiring impedance.

■Install a capacitor Co near the output pins (within 50mm from the pins).

Table 2.2 Recommended capacitance Co [μF]

Model / Output voltage (V)	Temperature of base plate Tc=−10 to +100℃	Tc=−40 to +100℃
	DCS1400B	DCS1400B
12	2200	2200×3parallel
24	2200	2200×3parallel
28	1000	1000×3parallel
36	1000	1000×3parallel
48	680	680×3parallel
65	330	330×3parallel

■The specified ripple and ripple noise are measured by the method introduced in Fig.2.5.

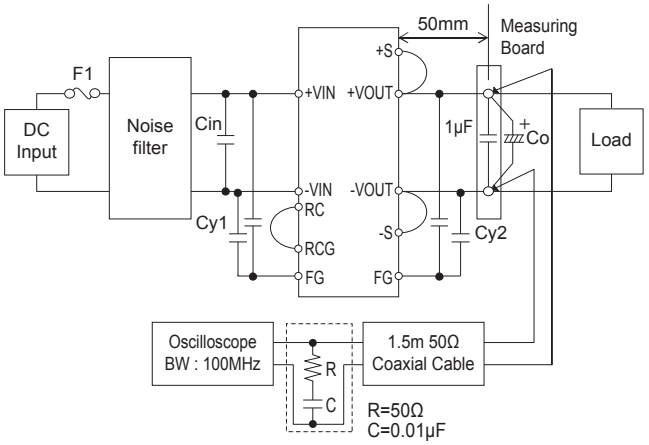

Fig.2.5 Method of Measuring Output Ripple and Ripple Noise

3 Function

3.1 Overcurrent protection

■Overcurrent protection is built-in and comes into effect over 105% of the rated current.
Overcurrent protection prevents the unit from short circuit and overcurrent condition. The unit automatically recovers when the fault condition is cleared.

■When the output voltage drops at overcurrent, the average output current is reduced by hiccup operation of power supply.

3.2 Overvoltage protection

■Overvoltage protection circuit is built in. If the overvoltage protection circuit is activated, the output voltage recovers from protection by lowering the input to 100VDC or less, waiting for more than 5 seconds, and then turning on the DC input again. Alternatively, it can also be reset using the remote ON/OFF control function.

Remarks:

Please note that devices inside the power supply might fail when voltage more than rated output voltage is applied to output terminal of the power supply. This could happen when the customer tests the overvoltage performance of the unit.

3.3 Thermal detection

■When the base plate temperature is kept above the Derating, the thermal protection will be activated and shut off the output.

Output voltage recovers from protection by shutting down the input voltage, and turning on DC input again after the internal power supply has cooled sufficiently. Alternatively, it can also be reset using the remote ON/OFF control function.

3.4 Remote ON/OFF

■The remote ON/OFF function is incorporated in the input circuit and operated with RC and RCG.

■When power supply shut off by over voltage protection or thermal protection, it can be recovered by toggling Remote ON/OFF signal.

■Remote ON/OFF circuit (RC, RCG) is on the primary side (input side), and the RCG is connected to the −VIN terminal inside the power supply. If it is controlled via an input filter or from the secondary side, insulate it with a photocoupler or similar. (Fig. 3.1(b))

■If positive logic control is required, order the power supply with "−R" option.

■When remote ON/OFF function is not used, please short between RC and RCG.

Table 3.1 Remote ON/OFF connection

No.	Item		RC, RCG
1	Connection method		Fig.3.1 (a) (b)
2	Base pin		RCG
3	Standard : Negative	Output ON	SW SHORT (1.0V max)
4		Output OFF	SW OPEN (3.5V min)
5	Optional −R : Positive	Output ON	SW OPEN (3.5V min)
6		Output OFF	SW SHORT (1.0V max)

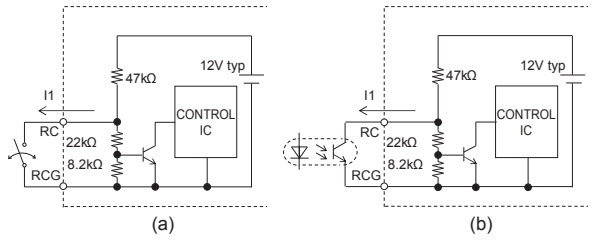

Fig.3.1 Examples of connecting remote ON/OFF circuit

■When the DPFseries (Power factor & harmonic corrector module) is used as a front end unit, connect between RC pin and ENA pin on DPF for the start-up time of the DCS1400B control. Please contact us for details.

3.5 Remote sensing

■Remote sensing is built-in.

(1) When the remote sensing function is not in use

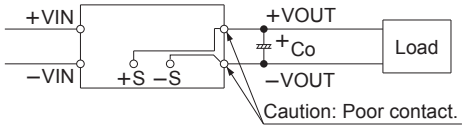

Fig.3.2 Connection when the remote sensing is not in use

■When the remote sensing function is not in use, it is necessary to confirm that pins are shorted between +S & +VOUT and between −S & −VOUT.

■Wire between +S & +VOUT and between −S & −VOUT as short as possible.

Loop wiring should be avoided.

This power supply might become unstable by the noise coming from poor wiring.

(2) When the remote sensing function is in use

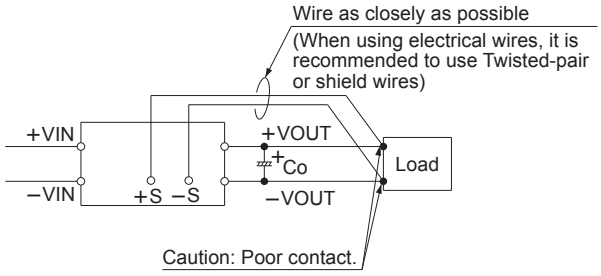

Fig.3.3 Connection when the remote sensing is in use

■Twisted-pair wire or shield wire should be used for sensing wire.

■Thick wire should be used for wiring between the power supply and a load.

Line drop should be less than 0.5V.

Voltage between +VOUT and −VOUT should remain within the output voltage adjustment range.

■If the sensing patterns are short, heavy-current is drawn and the pattern may be damaged.

The pattern disconnection can be prevented by installing the protection parts as close as a load.

3.6 Adjustable voltage range

■Output voltage between +VOUT and −VOUT can be adjusted by connecting external resistors to VTRM or by applied voltage externally.

■When the output voltage is adjusted to less than the adjustment voltage range, the output ripple voltage might increase.

■When the output voltage adjustment is not used, open the VTRM pin.

(1) Output voltage adjustment by potentiometer

■By connecting the external potentiometer (VR1) as shown in Fig.3.4, output voltage becomes adjustable.

■The wiring to the potentiometer should be as short as possible.
As the ambient temperature fluctuation characteristics deteriorate depending on the types of resistors and potentiometers, please use resistors and potentiometers of the following specifications:
Potentiometers ·····Cermet type, coefficient less than ±300ppm/℃

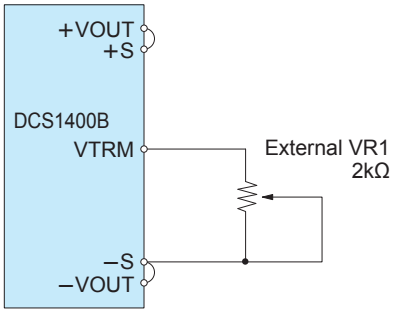

Fig.3.4 Connecting External Devices

(2) Output voltage adjustment by external voltage

■By applying a voltage externally to VTRM, output voltage becomes adjustable.
Output level is able to be calculated by following equation when the VTRM terminal voltage. However, it cannot be set beyond the upper limit of the output voltage variable range.

$$\text{Output voltage [V]} = \frac{\text{The voltage between VTRM and } -\text{S[V]}}{1.0\ \text{[V]}} \times \text{Rated output voltage [V]} \quad \cdots ①$$

■Do not set the external applied voltage of the terminal to −0.3V or less, and 5.0V or more.

■When the VTRM terminal voltage is 4.5V or higher, the rated voltage is output.

■Do not set the VTRM terminal voltage within the range of 4.0 to 4.5V, because the output voltage to be indefinite.

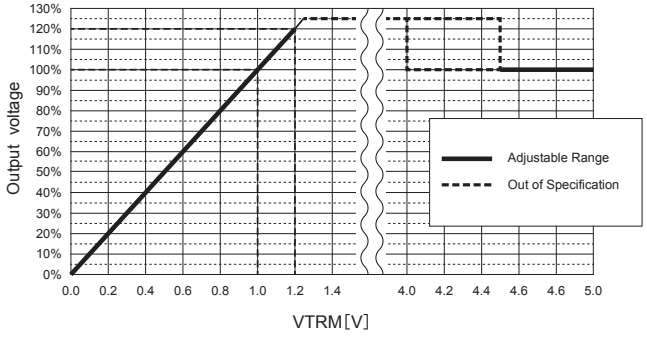

Fig.3.5 VTRM-Output Voltage

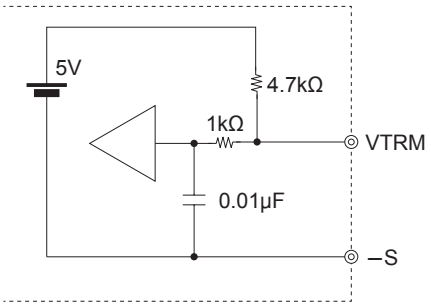

Fig.3.6 VTRM circuit

3.7 Adjustable constant current range

■Output current for the constant current can be adjusted by connecting external resistors to ITRM or by applied voltage externally.

■When the output current is adjusted to around 0A, the unit might be unstable.

■When the output current adjustment is not used, open the ITRM pin.

(1) Constant current adjustment by potentiometer

■By connecting the external potentiometer (VR2) as shown in Fig.3.7, output current for constant current becomes adjustable.

■The wiring to the potentiometer should be as short as possible.
As the ambient temperature fluctuation characteristics deteriorate depending on the types of resistors and potentiometers, please use resistors and potentiometers of the following specifications:

Potentiometers ·····Cermet type, coefficient less than ±300ppm/℃

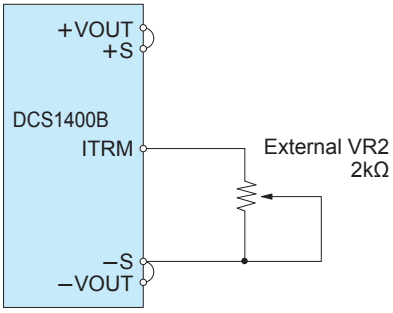

Fig.3.7 Connecting External Devices

(2) Constant current adjustment by external voltage

■By applying a voltage externally to ITRM, output current for constant current becomes adjustable.
When the ITRM terminal voltage is set at less than 1.0 V, the constant current set value can be changed.

$$\text{Output current [A]} = \frac{\text{The voltage between ITRM and } -\text{S[V]}}{1.0\ \text{[V]}} \times \text{Rated output current [A]} \quad \text{...②}$$

■Do not set the external applied voltage of the terminal to −0.3 V or less, and 5.0 V or more.

■During operation, please change the voltage at the ITRM terminal gradually (no more than 0.01 V/ms). A sudden change may cause instability in constant current operation.

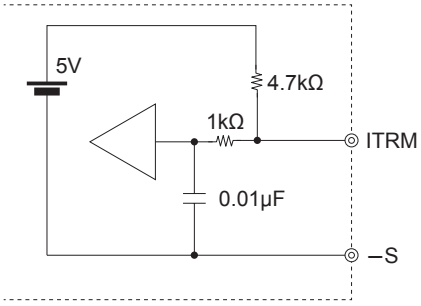

Fig.3.8 ITRM circuit

Note :

■If the output voltage becomes less than 5% of the rated voltage during constant current operation, the output may become unstable.

3.8 Power good (PG)

■By using PG, it is possible to monitor power supply whether normal operation or abnormal operation. The PG signal is “Low” when the power supply operates correctly. The signal turns to “High” when the power supply stops.

■PG circuit is designed as shown in Fig.3.9. Sink current of PG is 15mA max.

Notes when you use PG signal are shown below.

① The PG signal is “High” when the output voltage is 20% or less of the rated output voltage or 60% or less of the output voltage setting value,

② The PG signal is “Low” when the power supply operates during constant current.

Table 3.2 Specification of PG

No.	Item	PG
1	Function	Normal operation “Low”
		The power supply stops “High”
2	Base pin	−S
3	Level voltage “L”	0.5V max at 5mA
4	Level voltage “H”	Open corrector
5	Maximum sink current	15mA max
6	Maximum applied voltage	50V max

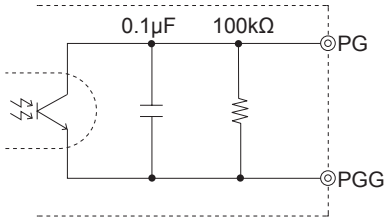

Fig.3.9 Internal circuit of PG

3.9 AUX for Power good circuit

■The AUX can be used as the power source for PG circuit.

■AUX is designed as shown in Fig.3.10, and a resistor (1.1kΩ) is built in to protect the short circuit. Output voltage decreases as the output current increases.

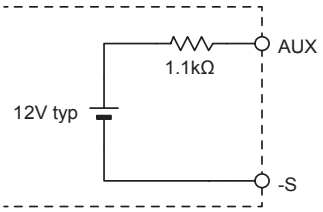

Fig.3.10 AUX circuit

3.10 Withstanding Voltage/Isolation Voltage

■When testing the withstanding voltage, make sure the voltage is increased gradually. When turning off, reduce the voltage gradually by using the dial of the hi-pot tester. Do not use a voltage tester with a timer as it may generate voltage several times as large as the applied voltage.

4 Series and Parallel Operation

4.1 Series operation

■It is possible to connect multiple output voltages in series in order to obtain higher output voltage.

■The maximum combined output voltage of series operation is 400V.

Notes :

① Please note that the maximum current available to the load is equal to the current of the lowest rated supply in the string.

② In case of malfunction (Failure or protection circuit activation), please stop the operation and replace the failed power supply.

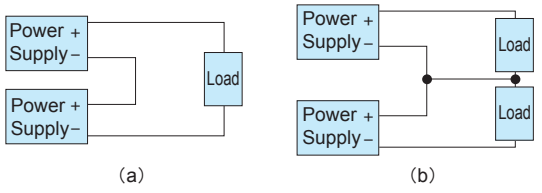

Fig.4.1 Examples of connecting in series operation

4.2 Parallel operation

■Parallel operation is available by connecting the units as shown in Fig.4.2. With this wiring, it is possible to adjust all output in module by single potentiometer. When output voltage adjustment is not in use, VTRM wiring, VR1 are not necessary.

■Constant current adjustment can be used, even in parallel operation. By changing the ITRM voltage of one power supply, constant current adjustable for all power supplies. It is not necessary to connect the ITRM terminals together.

■Total current should not exceed the value calculated by the following equation, and total number of units should be no more than 12 pieces.

(Output current at parallel operation)
= (the rated current per unit) × (number of unit) × 0.95

■Please make sure that the wiring impedance of a load from each power supply becomes even.

■Voltage drop from a power supply to the sensing point should be less than 0.5V for stable control.

■If temperatures of aluminum base plates are different in the power supply for parallel operation, the difference in output current becomes large. Design radiation to equalize plate temperatures by attaching the same heat sinks.

■Connect the sensing line and the power line by one point after connecting each power supply's sensing pins (+S, −S).

■If the output current is less than 2% of the rated current, the output voltage ripple will be large.

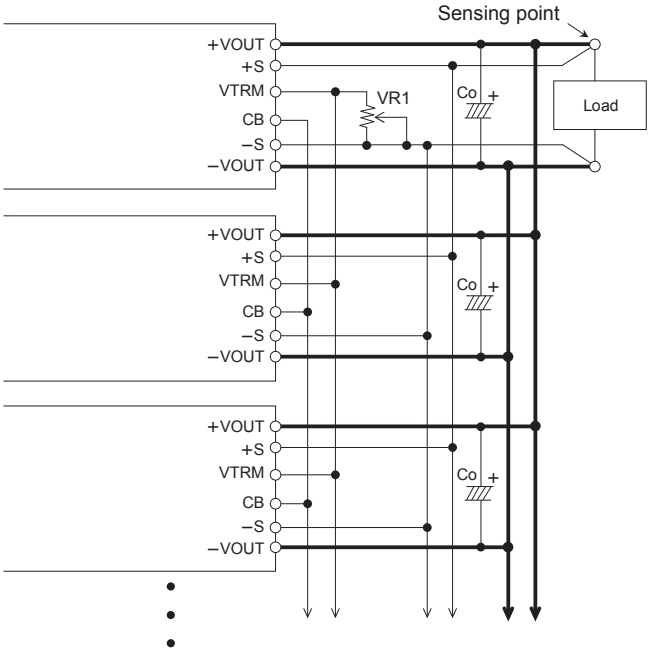

Fig.4.2 Examples of parallel operation

■Please refer to the application manuals for details of parallel operation.
Application manual is on our web site.

4.3 N+1 redundant operation

●-P2

■The -P2 option features a built-in ORingFET, enabling N+1 redundant operation without the need for an external ORing device.

■If you add one extra power supply in parallel operation, even if one of the power supplies in your system fails, the remaining power supplies continue to function.

■The specifications of the -P2 option differ from the standard product in the following

(a) Output voltage adjustment range
The output voltage cannot be adjusted to 5.5V or less.

(b) Low voltage protection
If the output voltage drops to 5V or less, the low voltage protection circuit will operate and the output will latch stop. The latched stop operation can be released by reducing the DC input to 100V or less and resuming operation after 5 seconds. Alternatively, it can also be reset using the remote ON/OFF control function.

■Please shut off the input voltage when you replace a failed power supply.

■Hot-swap or Hot-plug is not available.

■2 or more power supplies failures may cause the output voltage to decrease and the system to shut down. Immediate replacement is recommended when a power supply has failed.

■Please contact us for the detail of series, parallel and N+1 redundancy operations.

5 Cleaning

■Clean the product with a brush. Prevent liquid from getting into the product.
Do not soak the product into liquid.
■Do not stick solvent to a name plate or a resin case.
(If solvent sticks to a name plate or a resin case, it will cause to change the color of the case or to fade letters on name plate away.)
■After cleaning, dry them enough.

6 Lifetime expectancy depends on stress by temperature difference

■Regarding lifetime expectancy design of solder joint, following contents must be considered.
It must be careful that the soldering joint is stressed by temperature rise and down which is occurred by self-heating and ambient temperature change.
The stress is accelerated by thermal-cycling, therefore the temperature difference should be minimized as much as possible if temperature rise and down is occurred frequently.
■Product lifetime expectancy depends on the aluminum base plate central temperature difference (ΔTc) and number of cycling in a day is shown in Fig.6.1.
If the aluminum base plate center part temperature changes frequently by changing output load factor etc., the above the lifetime expectancy design should be applied as well.

Please contact us for details.

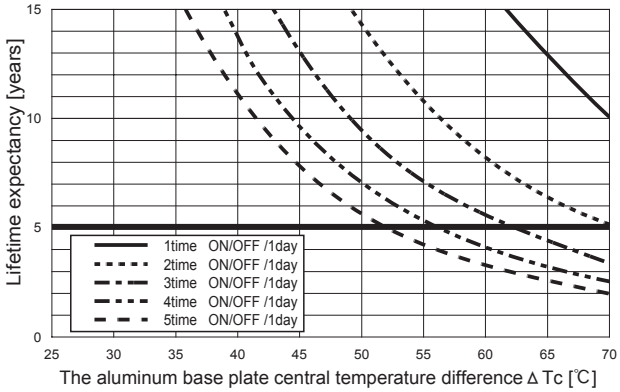

Fig.6.1 Lifetime expectancy against rise/fall temperature difference

Application manuals available at our website.
Recommended external components are also introduced for your reference.