FETA

Basic Characteristics Data

Model	Circuit method	Switching frequency [kHz]	Input current [A]	Rated input fuse	Inrush current protection circuit	PCB/Pattern			Series/Parallel operation availability	
						Material	Single sided	Double sided	Series operation	Parallel operation
FETA2500B	Active filter	47	13.8	250V 30A	Relay	FR-4		Yes	Yes	Yes
	Phase-shift Full-bridge converter	94								

* The value of input current is at ACIN 200V and rated laod.

1 Terminal Blocks FETA-6

2 Functions FETA-6

2.1 Input Voltage Range FETA-6
2.2 Inrush Current Limiting FETA-6
2.3 Overcurrent Protection FETA-6
2.4 Overvoltage Protection FETA-6
2.5 Low-voltage Protection FETA-6
2.6 Thermal Protection FETA-7
2.7 Output Voltage Adjustment Range FETA-7
2.8 Output Ripple and Ripple Noise FETA-7
2.9 Remote ON/OFF FETA-7
2.10 Isolation FETA-8
2.11 Signal Output (LED / Warning / Alarm) FETA-8
2.12 Sequence Diagram FETA-9

3 Series/Parallel Operation FETA-9

3.1 Series Operation FETA-9
3.2 Parallel Operation/Master-slave Operation FETA-10
3.3 N+1 Parallel Redundancy Operation FETA-10

4 Assembling and Installation Method FETA-10

4.1 Installation Method FETA-10
4.2 Derating FETA-11
4.3 Expected Life and Warranty FETA-11

5 Others FETA-12

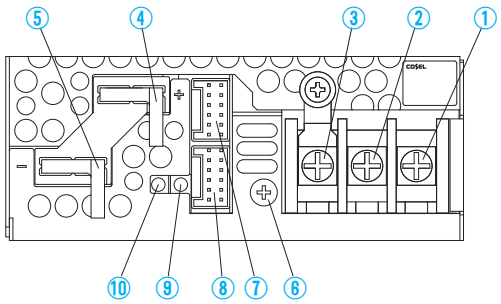
5.1 Output Current Monitor FETA-12
5.2 Auxiliary Power (AUX) FETA-12
5.3 Output Capacitive Load Considerations FETA-12
5.4 External Component (EMI/EMC Filter) FETA-12
5.5 Ground FETA-12
5.6 Variable Speed Fan FETA-12

6 Options FETA-13

6.1 Outline of Options FETA-13

FETA

1 Terminal Blocks



①AC (L) } Input Terminals AC170 - 264V 1φ47 - 63Hz
②AC (N) } (M4)
③Frame ground (M4 ⏚)
④+Output
⑤–Output
⑥Output voltage adjustable potentiometer
⑦CN1 } Connectors
⑧CN2 }
⑨LED for output voltage confirmation (DC_OK)
⑩LED for fault condition detection (ALARM)

Table 1.1 Pin Configuration and Functions of CN1, CN2

Pin No.	Pin Name	Function
1	AUXG	Auxiliary power output (GND)
2	AUX	Auxiliary power output
3	WRNG	Warning signal (GND)
4	WRN	Warning signal
5	PGG	Alarm signal (GND)
6	PG	Alarm signal
7	RCG	Remote ON/OFF (GND)
8	RC	Remote ON/OFF
9	COM	Signal ground
10	TRM	Adjustment of output voltage
11	VB	Voltage Balance
12	CB	Current Balance

Table 1.2 Matching connectors and terminals on CN1, CN2

Connector		Housing	Terminal	Mfr.
CN1	S12B-PUDSS-1	PUDP-12V-S	Reel : SPUD-001T-P0.5 or SPUD-002T-P0.5	J.S.T
CN2				

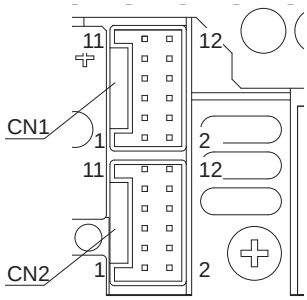


Fig.1.1 Connector pin numbers

2 Functions

2.1 Input Voltage Range

■Input voltage range of the power supplies is from AC170V to AC264V.
■In cases that conform with safety standard, input voltage range is AC200-AC240V (50/60Hz).
■If input value doesn't fall within above range, a unit may not operate in accordance with specifications and/or start hunting or fail.
If you need to apply a square waveform input voltage, which is commonly used in UPS and inverters, please contact us.
■When the input voltage changes suddenly, the output voltage accuracy might exceed the specification. Please contact us.

2.2 Inrush Current Limiting

■An inrush current limiting circuit is built-in.
■If you need to use a switch on the input side, please select one that can withstand an input inrush current.
■Relay technique is used in the inrush current limiting circuit. When you turn the power ON/OFF repeatedly within a short period of time, please have enough intervals so that the inrush current limiting circuit becomes operative.
■When the switch of the input is turned on, the primary inrush current and secondary inrush current will be generated because the relay technique is used for the inrush current limiting circuit.

2.3 Overcurrent Protection

■An overcurrent protection circuit is built-in and activated at 105% - 120% of the rated current. A unit automatically recovers when a fault condition is removed.
Please do not use a unit in short circuit and/or under an overcurrent condition.
■Low-voltage protection is activated when output voltage is reduced by over current protection under the low-voltage protection value.

2.4 Overvoltage Protection

■An overvoltage protection circuit is built-in. If the overvoltage protection circuit is activated, shut down the input voltage, wait 10 or more seconds and turn on the AC input again to recover the output voltage.
Note :
■Please avoid applying a voltage exceeding the rated voltage to an output terminal. Doing so may cause a power supply to malfunction or fail. If you cannot avoid doing so, for example, if you need to operate a motor, etc., please install an external diode on the output terminal to protect the unit.

2.5 Low-voltage Protection

■Low-voltage protection is built-in. This protection will shut down the output with the activation. To restart the output, recycle AC input after 10 or more seconds.

2.6 Thermal Protection

■A thermal protection circuit is built-in.

The thermal protection circuit may be activated under following conditions and shut down the output.

①When a current and a temperature continue to exceed the values determined by the derating curve.

②When a fan stops or air flow weakens by intake port or exhaust port is blocked.

If the thermal protection circuit is activated, shut off the input voltage and eliminate all the overheating conditions. To recover the output voltage, have enough time to cool down the unit before turning on the input voltage again.

2.7 Output Voltage Adjustment Range

■To increase an output voltage, turn a built-in potentiometer clockwise. To decrease the output voltage, turn it counterclockwise.

■The power supplies have an external output voltage control function. The output voltage can be adjusted by changing the voltage between the terminal TRM and the terminal COM on CN1/CN2. You can decrease the voltage by drawing a current from the TRM terminal.

You can calculate the output voltage in this case from formula ① below.

Please note that the formula ① gives you only an estimate. Please contact us if you need accurate numbers.

Please do not apply negative Voltage to TRM terminal.

There is more than one method to adjust the output voltage, including the methods to use external resistors and external power supplies. Since each method has different characteristic, please contact us for details.

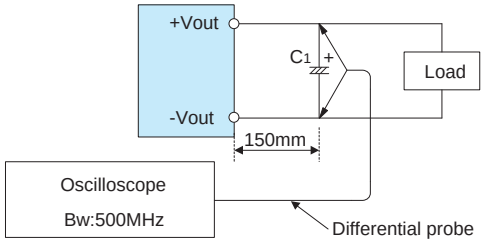
$$\text{Output voltage} = \frac{\text{The voltage between TRM and COM}}{2.5\ [\text{V}]} \times \text{rated output voltage} \cdots ①$$

Table 2.1 Output voltage adjustment range

Model	Output voltage adjustment range [V]
W/O option "Y1"	43.2 to 52.8
W/ option "Y1"	approximately 0 to 52.8

2.8 Output Ripple and Ripple Noise

■Output ripple noise may be influenced by measurement environment, measuring method Fig.2.1 is recommended.



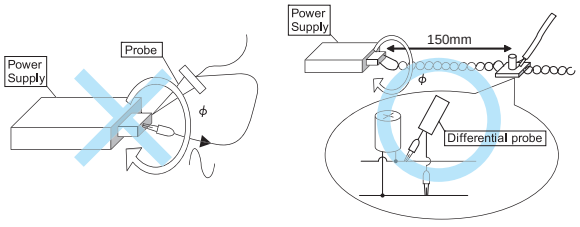
C1 : Aluminum electrolytic capacitor 22μF

Fig.2.1 Measuring method of Ripple and Ripple Noise

Remarks :

When GND cable of probe with flux of magnetic force from power supply are crossing, ripple and ripple noise might not measure correctly.

Please note the measuring environment.



Bad example Good example

Fig.2.2. Example of measuring output ripple and ripple noise

2.9 Remote ON/OFF

■These models have a remote ON/OFF function.

■You can operate the remote ON/OFF function by sending signals to CN1/CN2. Please see Table 2.2 and Table 2.3 for specifications and Fig.2.3 for connecting examples.

■Please note the followings when using the remote ON/OFF function.

①The output stops when a current flows to RC.

∗Reverse logic option (-R) also available. Refer to section 6.Option.

②The current flown to RC is a 20mA max.

③When the output voltage is turned off through the remote ON/OFF circuit, the built-in fan slows down.

④If the output voltage is turned off through the remote ON/OFF circuit, the WRN signals and the PG signals keep "Low".

⑤Description in this section is based on the assumption that you will use one unit alone. If you are planning to use the units in parallel operation or use multiple units for a single system, please check necessary voltage and current values.

■Please wire carefully. If you are wrongly, the internal components of a unit may be damaged.

■Remote ON/OFF circuits (RC and RCG) are isolated from input, output, FG, AUX, WRN and PG.

Table 2.2 Specifications of remote ON/OFF (RC-RCG)

Output voltage	Between RC and RCG
ON	L level (0 to 0.5V) or open
OFF	H level (4.5 to 12.5V)

Table 2.3 Specifications of remote ON/OFF (Case of Fig.2.3)

Connection method	Fig.2.3 (a)	Fig.2.3 (b)	Fig.2.3 (c)
Power ON	SW open (0.1mA max)		SW close (0.5V max)
Power OFF	SW close (3mA min)		SW open (0.1mA max)
Base pin	RCG	AUXG	RCG, AUXG

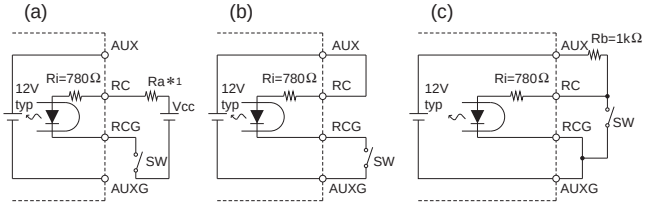


Fig.2.3 Examples of connecting remote ON/OFF circuit

FETA

∗1 If the output of an external power supply is within the range of 4.5 - 12.5V, you do not need a current limiting resistor Ra. If the output exceeds 12.5V, however, please connect the current limiting resistor Ra.
To calculate a current limiting resistance value, please use the following equation.

$$Ra[\Omega]=\frac{Vcc-(1.1+Ri\times 0.005)}{0.005}$$

2.10 Isolation

■When you run a Hi-Pot test as receiving inspection, gradually increase the voltage to start. When you shut down, decrease the voltage gradually by using a dial. Please avoid a Hi-Pot tester with a timer because, when the timer is turned ON or OFF, it may generate a voltage a few times higher than the applied voltage.

2.11 Signal Output (LED/Warning/Alarm)

■Functions of LED indicators and Output of Warning/Alarm are shown below. LED indicators and Output of Warning/Alarm are signals to check the presence/absence of voltage at the output terminal of a power supply and to detect warning/fault conditions. The timing of signals might be vary depending on input and load conditions. Please make sure enough evaluation.

Table 2.4 Description of LED indicator

LED indicator	Condition	Output voltage
OFF	Input power not present	OFF
Green - ON	Normal condition	ON
Green - Blinking	DC OFF by RC signal	OFF
Amber - Blinking	Warning condition (refer to Table.2.5)	ON
Amber - ON	Fault condition (refer to Table.2.6)	OFF

Table 2.5 Description of the Warnings (WRN signal)

Warning		Output of Warning
WRN	The WRN signals are "Low" when the power supply operates normally. The signals turn "High" when AC input voltage is wrong (AC<170V, AC>264V) or DC output voltage is wrong(DC output voltage is out of voltage adjustment range.) or fan alarm/thermal warning is detected.	Open collector method Good : L level (0 to 0.5V at 3mA) Bad : H level or Open (35Vmax)

Table 2.6 Description of the alarms (PG signal)

Alarm		Output of Alarm
PG	The PG signals are "Low" when the power supply operates normally. The signals turn "High" when the fan stops or the power supply stops as a result of output voltage decrease/stop, activation of thermal protection, overvoltage protection, Low-Voltage protection functions or wrong input voltage is applied.	Open collector method Good : L level (0 to 0.5V at 3mA) Bad : H level or Open (35Vmax)

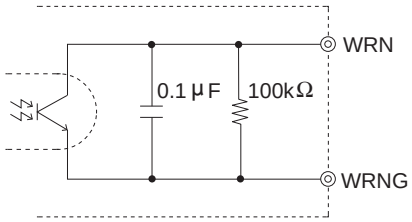


Fig.2.4 Internal circuit of WRN

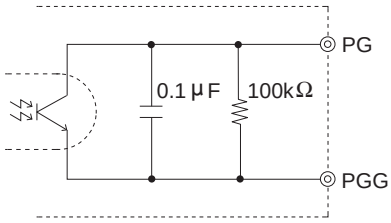


Fig.2.5 Internal circuit of PG

■Please note the followings when you use the warnings (WRN signal) and the alarms (PG signal).
① The time it takes until the WRN signals and the PG signals turn "High" vary depending on conditions.
② If the output voltage is turned off through a remote ON/OFF circuit, the WRN signals and the PG signals keep "Low".

■The WRN signal (Warning) circuit and the PG signal (Alarm) circuit are isolated from input, output, FG, RC and AUX.

2.12 Sequence Diagram

(1)Turn ON/OFF by Remote ON/OFF control

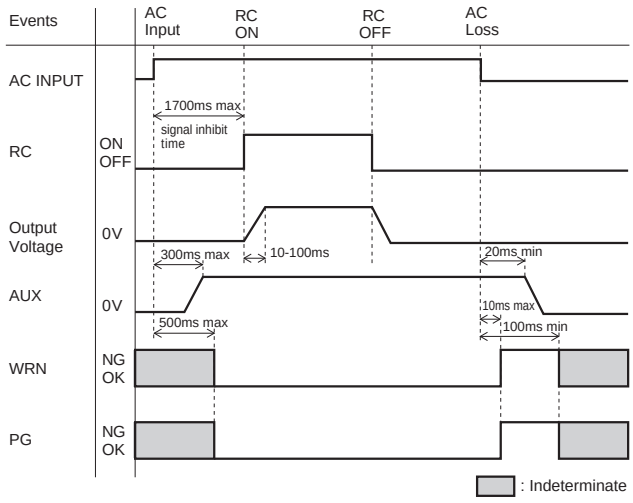


Fig.2.6 Sequence time chart by Remote ON/OFF control

(2)Turn ON/OFF by AC Input / Loss

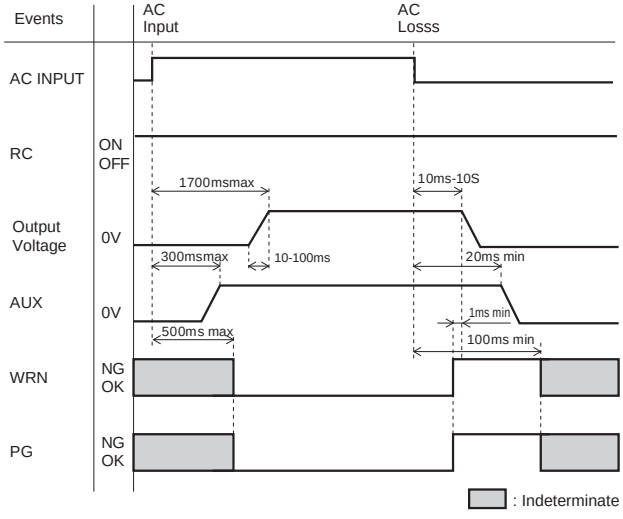


Fig.2.7 Sequence time chart by AC Input / Loss

3 Series/Parallel Operation

FETA

3.1 Series Operation

■It is possible to connect multiple output voltages in series in order to obtain higher output voltage. However care should be taken as follows:

Notes of (a) and (b) :

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.

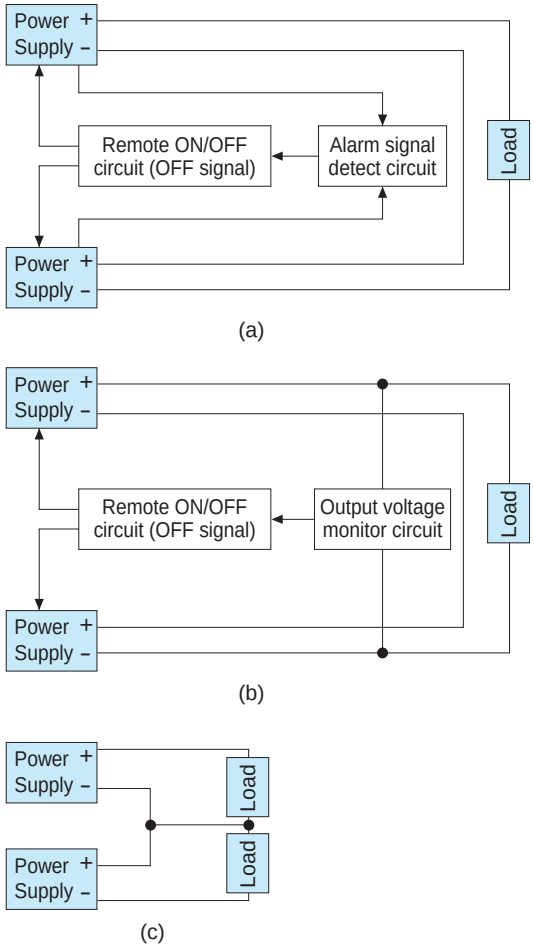


Fig.3.1 Examples of connecting in series operation

FETA

3.2 Parallel Operation/Master-slave Operation

■You can use the power supplies in parallel operation by connecting units as shown in Fig.3.2.
Please parallelly connect VB, CB and COM of each power supply in parallel operation.

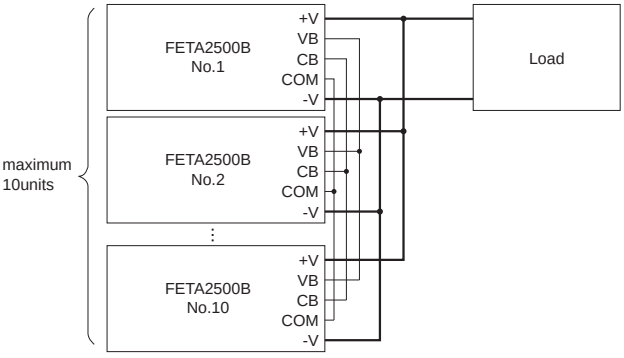


Fig.3.2 Example of parallel connection

■Differences in the output current values among the power supplies in parallel connection are 5% at most. Please make sure that the sum of the output current values does not exceed a value obtained from the following equation.

(Output current in parallel operation)
= (Rated current per unit) × (Number of units) ×0.95

■When the number of units in parallel operation increases, the input current also increases. Please design input circuitry (including circuit pattern, wiring and current capacity for equipment) carefully.
■Please make sure that the wiring impedance of a load from each power supply becomes even. Otherwise, the output current balance circuit may become inoperative.
■The maximum number of units you can use in parallel operation is 10.
■You can adjust the output voltage in parallel operation by adjusting a potentiometer of just one power supply.
To do so, select one power supply as the master unit and turn the potentiometers of the other (slave) power supplies clockwise to the end.
Once you have done this, you can adjust the output voltage by turning the potentiometer of the master unit.
■Parallel connection with other products is not allowed.

3.3 N+1 Parallel Redundancy Operation

■You can have N+1 redundancy operation for improved system reliability.
■N+1 redundancy operation is possible by connecting units as shown in Fig.3.3.
VB, CB and COM are also connected together between all units in parallel.
■Output current calculation is required based on following equation.
The current has to be more over normal operation current even if one power supply fails.

Maximum output current ≦ Rated current per unit × Numbers of normal operated units × 0.95

■If you add one extra power supply in parallel operation, even if one of the power supplies in your system fails, the remaining non-failed power supplies continue to sustain the system. If one of the power supplies stops operating, the output voltage may change about 5%.
■Parallel with other products is not allowed.
■Please shut off the input voltage when you replace a failed power supply.
■After replacement, please make sure that all wirings are completed correctly, before re-applying input voltage.
■Hot-swap or Hot-plug is not available.
■2 or more power supplies failures may cause the output voltage to decrease, lending the application system to shut down. Immediate replacement is recommended when a power supply has failed.

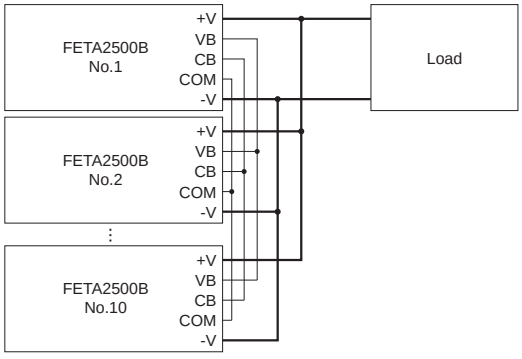


Fig.3.3 Example of N+1 redundancy operating connection

■If you have any questions about series, parallel and N+1 redundancy operations, please contact us.

4 Assembling and Installation Method

4.1 Installation Method

■Screw mounting has to be consider the product weight for safety fixture.
■To keep enough insulation distance between screws and internal components, length of the mounting screw should not exceed recommendation as following Table4.1.

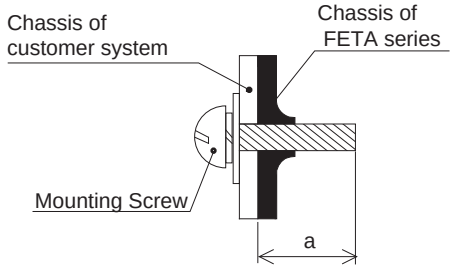


Fig.4.1 Mounting screw

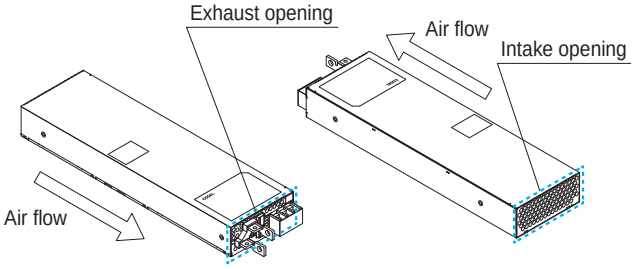
Table 4.1 Max penetration length

Mounting hole	a (Max penetration length)
Bottom	6mm max
Side	4.5mm max

■The power supplies have a built-in forced cooling fan. Do not block ventilation at the suction side and its opposite side.

✻Option with reversed airflow (-F2) is also available. Refer to section 6.Option.

■If you use a power supply in a dusty environment, it can give a cause for a failure. Please consider taking such countermeasures as installing an air filter near the suction area of the system to prevent a failure.



(a) Front side (b) Rear side

Fig.4.2 Location of intake port and exhaust port

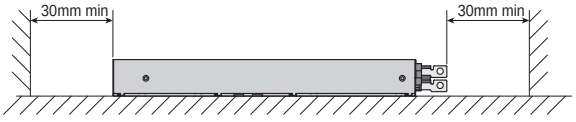
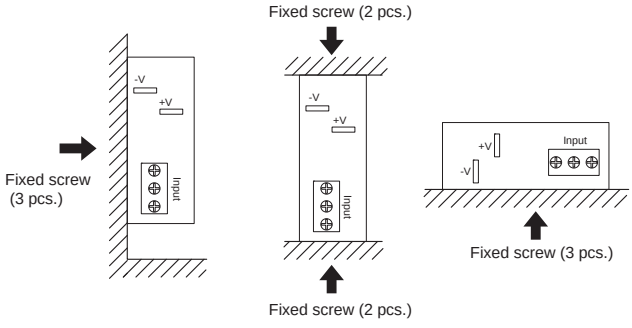


Fig. 4.3 Clearance of intake port and exhaust port

■When mounting the power supply with screws, it is recommended that this be done as shown in Fig.4.4. If other methods are used, be sure the weight of the power supply is taken into account.



(A) (B) (C)

Fig.4.4 Installation method

4.2 Derating

■Input Voltage Derating Curve

Input voltage derating curve is shown in Fig.4.5.

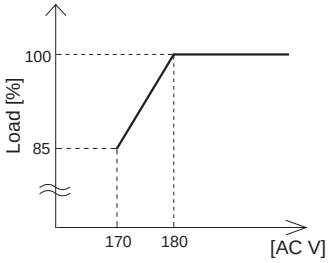


Fig.4.5 Input voltage derating curve

■Ambient Temperature Derating Curve

Derating curve depending on an ambient temperature is shown in Fig.4.6.

✻Specifications for ripple and ripple noise changes in the shaded area.

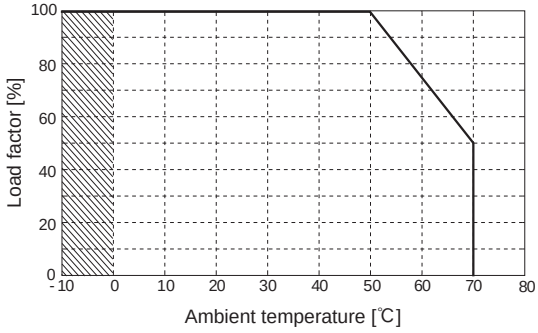


Fig.4.6 Ambient temperature derating curve

4.3 Expected Life and Warranty

■Expected Life

Please see the following tables for expected life.

Table.4.2 Expected lifetime

Mounting	Cooling method	Average ambient temperature	Expected lifetime [years]	
			Io = 50%	Io = 100%
All direction	Forced air cooling (internal fan)	Ta = 35℃ or less	6	5
		Ta = 50℃	4	3
		Ta = 70℃	2	–

✻This lifetime includes a built-in fan lifetime.

FETA

■Life expectancy (R(t)=90%) of fan depends on use conditions as shown in Fig.4.7.

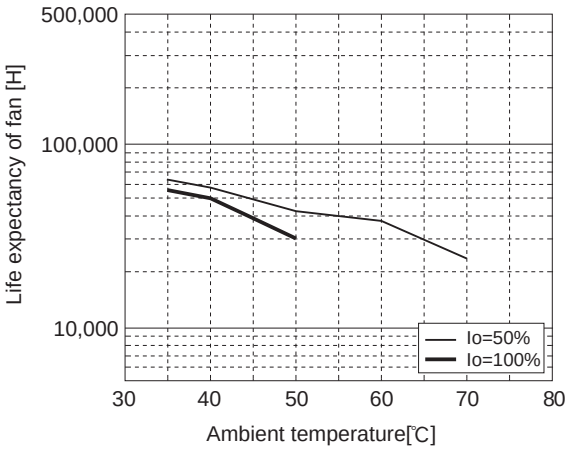


Fig.4.7 Life expectancy of fan

■Warranty

Please see the following table for warranty. The warranty period is 5 years maximum.

Table.4.3 Warranty

Mounting	Cooling method	Average ambient temperature	Warranty [years]	
			Io = 50%	Io = 100%
All direction	Forced air cooling (internal fan)	Ta = 35℃ or less	5	5
		Ta = 50℃	3	3
		Ta = 70℃	1	–

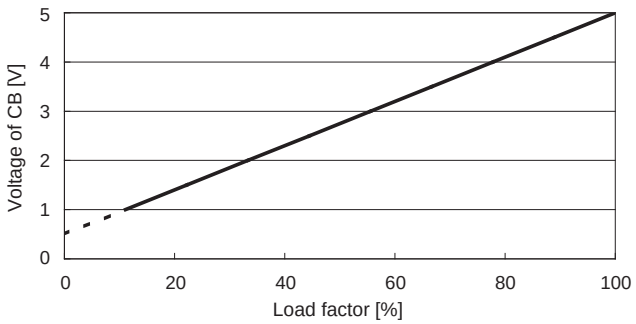
5 Others

5.1 Output Current Monitor

■You can monitor an output current by measuring a voltage between the terminal CB and COM.

■Fig.5.1 shows the relationship between the voltage of the terminal CB and the output current.

The output current shown in Fig.5.1 should be used only as a guide.



$$\text{Load factor} : \frac{\text{Output current}}{\text{Rated current}}$$

Fig.5.1 Load factor conversion graph

Note:

■Careful wire connection is needed to avoid a malfunction caused by noise.

■Use a measuring instrument which has 500kΩ input impedance or more.

■Do not short between CB and COM because of possibility of failure.

5.2 Auxiliary Power (AUX)

■The power supplies can generate an auxiliary power (AUX: 12V 0.15A) from CN1/CN2 to provide for remote ON/OFF and attached circuits.

■AUX circuit is isolated from other (input, output, FG, RC, WRN and PG) circuits.

■Please do not draw a current of 0.15A or higher from the auxiliary power because doing so could damage the internal circuits or cause malfunction.

When you connect a DC-DC converter, a current a few times higher than normal current may flow at start-up. Please check the current.

5.3 Output Capacitive Load Considerations

■The maximum of 22,000μF can be connected to the load side.

If you need to connect more than 22,000μF, please contact us for the assistance.

5.4 External Component (EMI/EMC Filter)

■You can have the power supplies comply with FCC Part 15 class B and CISPR22-B, EN55011-B, EN55022-B, VCCI-B by connecting an external EMI/EMC Filter.

Recommended EMI/EMC Filter
NAC-20-472 (COSEL)

5.5 Ground

■When installing the power supply with your unit, ensure that the input FG terminal is connected to safety ground of the unit.

5.6 Variable Speed Fan

■The power supply has built-in variable speed cooling fan. The fan speed is a function of load and ambient temperature.

6 Options

6.1 Outline of Options

✻Please inquire us for details of specifications and delivery timing.
✻You can combine multiple options. Some options, however, con not be combined with other options. Please contact us for details.

● -R

■Specification with reversed logic for remote ON/OFF operation. Remote ON/OFF specification of Option-R is on Table 6.1 and Table 6.2.

Table 6.1 Remote ON/OFF specification of Option-R (RC-RCG)

Output Voltage	Between RC and RCG
OFF	L level (0 to 0.5V) or Open
ON	H level (4.5 to 12.5V)

Table 6.2 Remote ON/OFF specification of Option-R (Case of Fig.2.3)

Connection method	Fig.2.3 (a)	Fig.2.3 (b)	Fig.2.3 (c)
Power OFF	SW open (0.1mA max)		SW close (0.5V max)
Power ON	SW close (3mA min)		SW open (0.1mA max)
Base pin	RCG	AUXG	RCG, AUXG

● -Y1

■The output voltage can be adjusted from approximately 0V to 110% by changing the voltage between the terminal TRM and the terminal COM.
The calculation formula is ① as following.

$$\text{Output voltage} = \frac{\text{The voltage between TRM and COM}}{2.5\text{V}} \times \text{rated output voltage} \cdots ①$$

■Output voltage factory setting is 48.00 - 49.92[V] (FETA2500B-48-Y1) / 36.00 - 37.44[V] (FETA2500B-36-Y1).
■Normal output voltage adjustment range is within 80-110% of the rated output voltage via built-in potentiometer.
■Negative voltage to TRM terminal may cause failure.
■The fan speed is higher than standard product under light load condition.
■Option -Y1 unit's derating curve depending on an ambient temperature is shown in Fig.6.1.

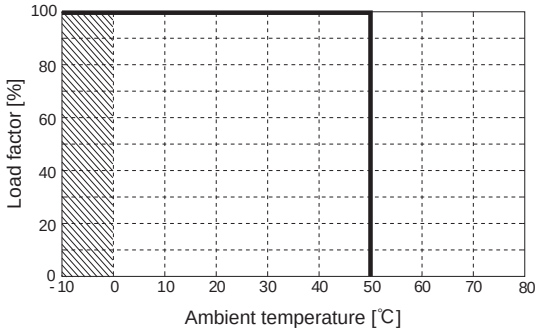
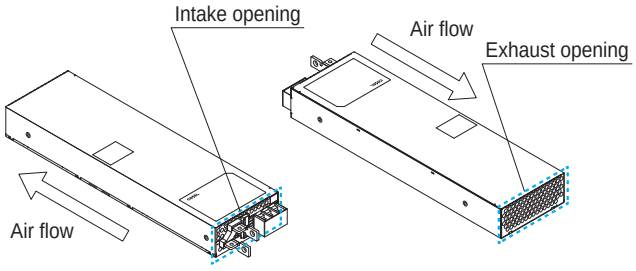


Fig.6.1 Ambient temperature derating curve

■Option -Y1 unit's electrical characteristic (efficiency, ripple) are different from standard products.

● -F2

■Specification with reversed air exhaust.
■Differences from standard products are shown in Fig.6.2 and Fig.6.3.
■Fan operates at higher speed compare to standard product at low ambient temperature.
■Please contact us for details about life expectancy of fan.



(a) Front side (b) Rear side

Fig.6.2 Location of intake port and exhaust port

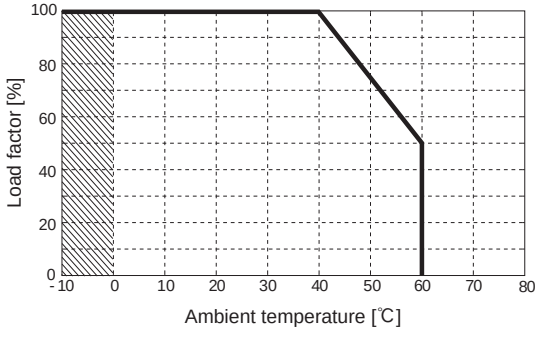


Fig.6.3 Ambient temperature derating curve