1 Functions

● FETA2500BA, 3000BA, 3000BC

1.1 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.

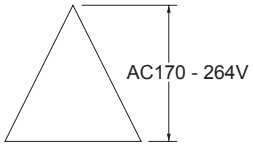
● FETA7000T

■The input voltage range is AC170-264V (three-phase).

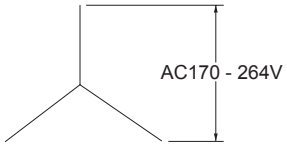
■In cases that conform with safety standard, input voltage range is AC200-AC240V (50/60Hz).

■The input phase line shall not be specified, it can be connected to any input terminal.

■In the case of three-phase four-wire system, connect the three wires to input terminal (L1, L2, L3), except ground wire.



Delta connection



Star connection

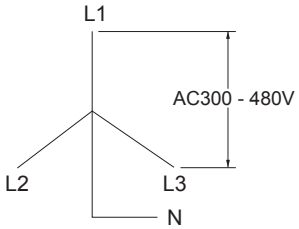
■If the wrong input or single phase input is applied, the unit will not operate properly and/or may be damaged. If you need to apply a square waveform input voltage, which is commonly used in UPS and inverters, please contact us.

● FETA7000ST

■The input voltage range is AC300-480V (three phase four wire).

■For the safety standard test, the input voltage range is AC346-415V (three phase four wire, 50/60Hz).

■The current flowing through the neutral line (N phase) increases when the AC input voltage is over AC456V three phase four wire (18Amax). This does not affect product quality. Please select a suitable wire gauge for the neutral line.



Three phase four wire system

■Three phase three wire input voltage is not supported.
The neutral line must be connected.
If the input voltage is not from three phase four wire connection or out of the specified range, the unit will not operate properly and/or may be damaged. If you need to apply a square wave form input voltage, which is commonly used in UPS and inverters, please contact us.

1.2 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.

1.3 Overcurrent Protection

■An overcurrent protection circuit is built-in and activated over 105% of the rated current. A unit automatically recovers when a faulty condition is removed.
Please do not use a unit in short circuit and/or under an overcurrent condition.

■Output voltage shuts down when the output voltage continuously drops due to overcurrent protection.

■Output voltage recovers from overcurrent protection by shutting down the input voltage and waiting more than 10 seconds then turning on AC input again, or turning off the output voltage by remote control.

1.4 Overvoltage Protection

■When output voltage is increased to the overvoltage protection value, output voltage is shut down.

■Output voltage recovers from overvoltage protection by shutting down the input voltage and waiting more than 10 seconds then turning on AC input again, or turning off the output voltage by remote control.

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.

1.5 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.

■Output voltage recovers from thermal protection by shutting down the input voltage and cooling down the inside of power supply adequately then turning on AC input again, or turning off the output voltage by remote control and cooling down the inside of power supply adequately then turning on the output voltage by remote control.

1.6 Output Voltage Adjustment Range

■To increase an output voltage, turn the 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 do not apply +5V or more or negative voltage between TRM and COM. 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.

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

If the output voltage decreases to 60% or less of rated voltage, output ripple may increase.

Table 1.1 Output voltage adjustment range

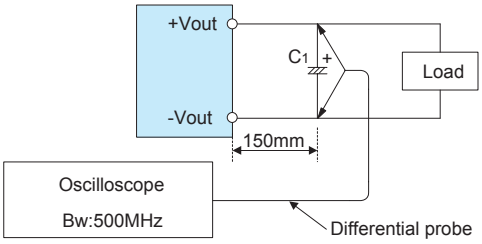
Model	Output voltage adjustment range [V]
FETA2500BA-36	approximately 0 to 39.6
FETA2500BA-48	approximately 0 to 52.8
FETA3000BA-48	approximately 15.0 to 52.8 ＊1
FETA3000BC-250	100 to 350 ＊2
FETA7000T-48	approximately 0 to 52.8
FETA7000T-144	approximately 0 to 158.4
FETA7000ST-48	approximately 0 to 52.8
FETA7000ST-144	approximately 0 to 158.4

＊1 The output voltage should not be adjusted to 15V or less because the ripple and ripple noise would be out of specs and the unit would make the audible noise.

＊2 The output voltage should not be adjusted to 100V or less.

1.7 Output Ripple and Ripple Noise

■Output ripple noise may be influenced by measurement environment, measuring method Fig.1.1 is recommended.



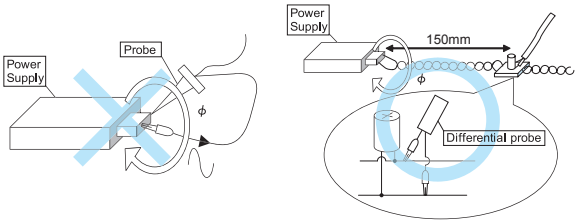
C1 : Aluminum electrolytic capacitor 22μF (Except FETA3000BC)
Film capacitor 2.2μF (FETA3000BC)

Fig.1.1 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.1.2. Example of measuring output ripple and ripple noise

1.8 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 (FETA3000BC : CN3). Please see Table 1.2 and Table 1.3 for specifications and Fig.1.3 for connecting examples.

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

①The output stops when a current flows to RC.

＊Reverse logic option (-R) is available for FETA2500BA, 3000BA, 3000BC. Refer to section 5. 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 done incorrectly, the internal components of the unit may be damaged.

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

Table 1.2 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 1.3 Specifications of remote ON/OFF (Case of Fig.1.3)

Connection method	Fig.1.3 (a)	Fig.1.3 (b)	Fig.1.3 (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

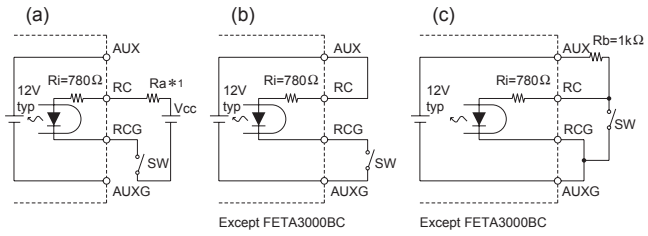


Fig.1.3 Examples of connecting remote ON/OFF circuit

*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.

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

1.9 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.

1.10 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 evaluate thoroughly.

Table 1.4 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.1.5)	ON
Amber - ON	Fault condition (refer to Table.1.6)	OFF

Table 1.5 Description of the Warnings

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 out of specification* or DC output voltage is wrong (DC output is out of voltage adjustment range) or fan fan alarm/termal warning is detected.	Open collector method Good : L level (FETA2500BA, FETA3000BA, FETA3000BC : 0 to 0.5V at 3mA FETA7000T FETA7000ST : 0 to 0.5V at 10mA) Bad : H level or Open (35Vmax)

*FETA7000ST
This does not affect product quality. The current flowing through the neutral line (N phase) increases when AC input voltage is over AC456V three phase four wire (18Amax). Select a suitable wire gauge for the neutral line.

Table 1.6 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, overcurrent protection functions or wrong input voltage is applied.	Open collector method Good : L level (FETA2500BA, FETA3000BA, FETA3000BC : 0 to 0.5V at 3mA FETA7000T, FETA7000ST : 0 to 0.5V at 10mA) Bad : H level or Open (35Vmax)

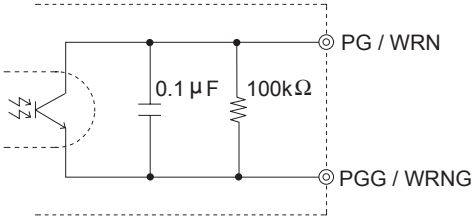


Fig.1.4 Internal circuit of PG / WRN of FETA2500BA, 3000BA, 3000BC

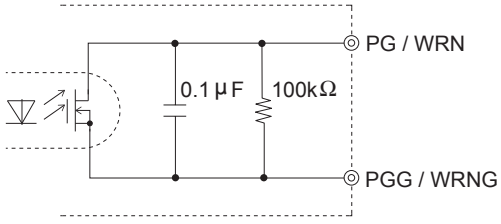


Fig.1.5 Internal circuit of PG / WRN of FETA7000T, 7000ST

■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.

1.11 Sequence Diagram

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

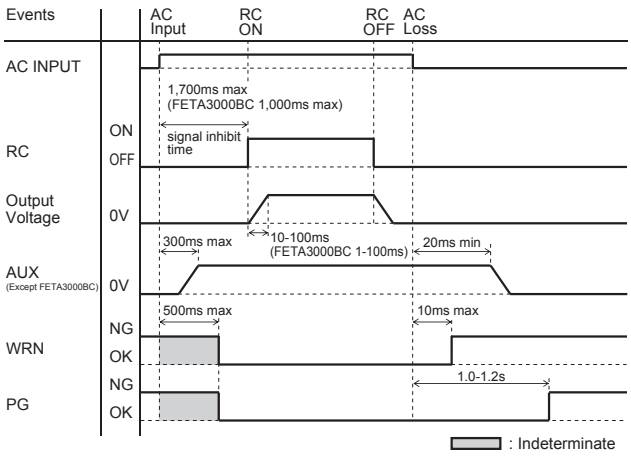


Fig.1.6 Sequence time chart by Remote ON/OFF control

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

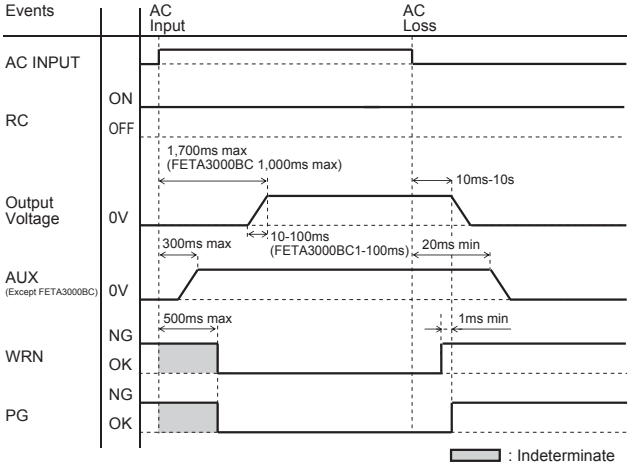


Fig.1.7 Sequence time chart by AC Input / Loss

2 Series/Parallel Operation

2.1 Series Operation

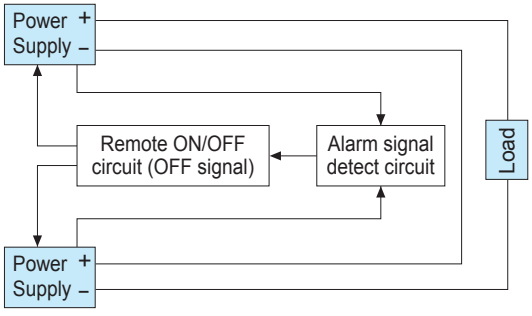
● FETA2500BA, 3000BA, 7000T, 7000ST

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

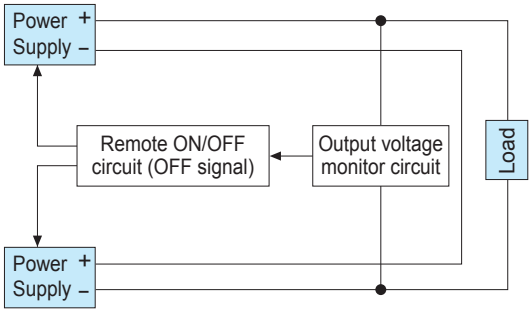
Notes of (a) and (b) :

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

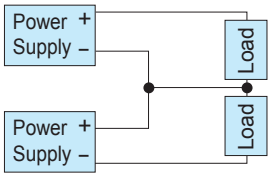
② In case of malfunction (Failure or protection circuit activation), please stop the operation and replace the failed power supply.



(a)



(b)



(c)

Fig.2.1 Examples of connecting in series operation

2.2 Parallel Operation/Master-slave Operation

■You can use the power supplies in parallel operation by connecting units as shown in Fig.2.2.
Please parallelly connect VB, CB and COM of each power supply in parallel operation.

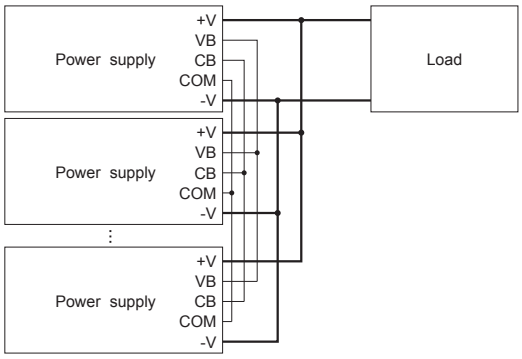


Fig.2.2 Example of parallel connection

■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 unit) ×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 in parallel operation for FETA2500BA, 3000BA, 3000BC are 10 and for FETA7000T, 7000ST are 3.

■You can adjust the output voltage in parallel operation by adjusting the 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.

2.3 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.2.3.
VB, CB and COM are also connected together between all units in parallel.

■The output voltage gap of paralleled units must be adjusted within +/-1,000mV for 250V type, +/-600mV for 144V type, and +/-200mV for the other output models.

■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.

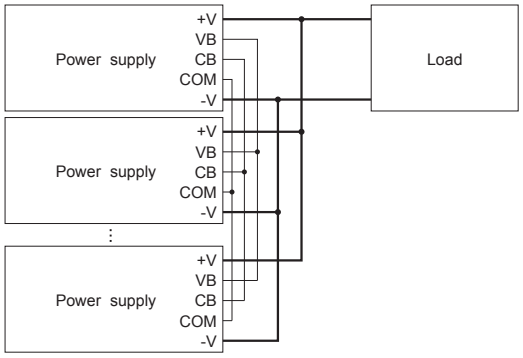


Fig.2.3 Example of N+1 redundancy operating connection

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

3 Life Expectancy and Warranty

● FETA2500BA

■Life Expectancy

Please see the following tables for life expectancy.

Table.3.1 Life Expectancy of FETA2500BA

Mounting	Cooling method	Average ambient temperature	Life Expectancy [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.

■Life expectancy (R(t)=90%) of fan depends on use conditions as shown in Fig.3.1.

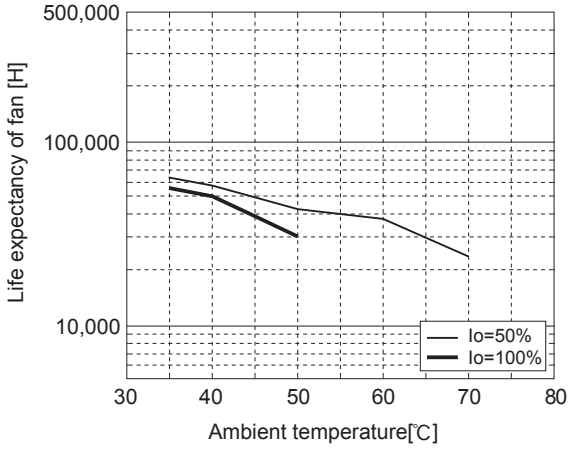


Fig.3.1 Life expectancy of fan of FETA2500BA

■Warranty

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

Table.3.2 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	–

● FETA7000T, 7000ST

■Life Expectancy

Please see the following tables for life expectancy.

Table.3.3 Life Expectancy of FETA3000BA

Mounting	Cooling method	Average ambient temperature	Life Expectancy [years]	
			Io = 50%	Io = 100%
All direction	Forced air cooling (internal fan)	Ta = 35℃ or less	6	4
		Ta = 50℃	4	3
		Ta = 70℃	1	–

＊This lifetime includes a built-in fan lifetime.

■Life expectancy (R(t)=90%) of fan depends on use conditions as shown in Fig.3.4.

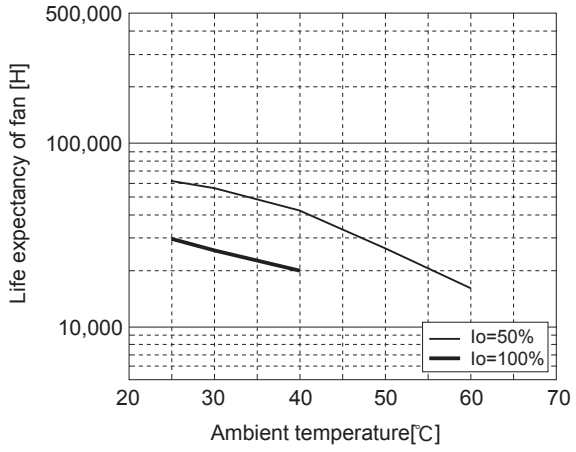


Fig.3.2 Life expectancy of fan of FETA3000BA

■Warranty

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

Table.3.4 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	4
		Ta = 50℃	3	3
		Ta = 70℃	1	–

● FETA3000BC

■Life Expectancy

Please see the following tables for life expectancy.

Table.3.5 Life Expectancy of FETA3000BC

Mounting	Cooling method	Average ambient temperature	Life Expectancy [years]	
			Io = 60%	Io = 100%
All direction	Forced air cooling (internal fan)	Ta = 35℃ or less	9	5
		35℃<Ta≦40℃	7	4
		40℃<Ta≦50℃	4	–
		50℃<Ta≦70℃	2	–

＊This lifetime includes a built-in fan lifetime.

■Life expectancy (R(t)=90%) of fan depends on use conditions as shown in Fig 3.3.

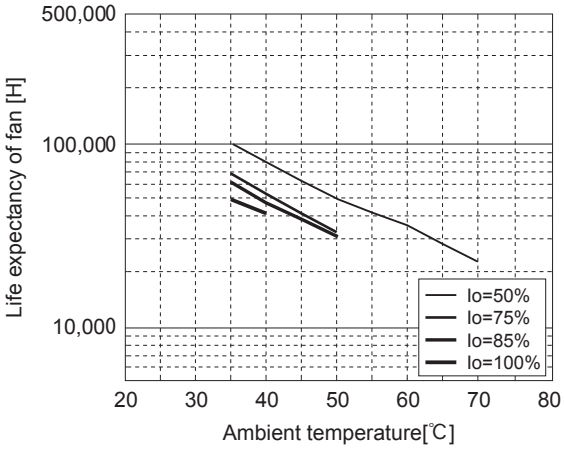


Fig.3.3 Life expectancy of fan of FETA3000BC

■Warranty

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

Table.3.6 Warranty

Mounting	Cooling method	Average ambient temperature	Warranty [years]	
			Io = 60%	Io = 100%
All direction	Forced air cooling (internal fan)	Ta = 35℃ or less	5	5
		35℃<Ta≦40℃	4	4
		40℃<Ta≦50℃	3	–
		50℃<Ta≦70℃	1	–

● FETA7000T, 7000ST

■Life Expectancy

Please see the following tables for life expectancy.

Table.3. 7 Life Expectancy of FETA7000T and FETA7000ST

Mounting	Cooling method	Average ambient temperature	Life Expectancy [years]	
			Io = 50%	Io = 100%
All direction	Forced air cooling (internal fan)	Ta = 40℃	7	5
		Ta = 60℃	4	–

✻This lifetime includes a built-in fan lifetime.

■Life expectancy (R(t)=90%) of fan depends on use conditions as shown in Fig 3.4.

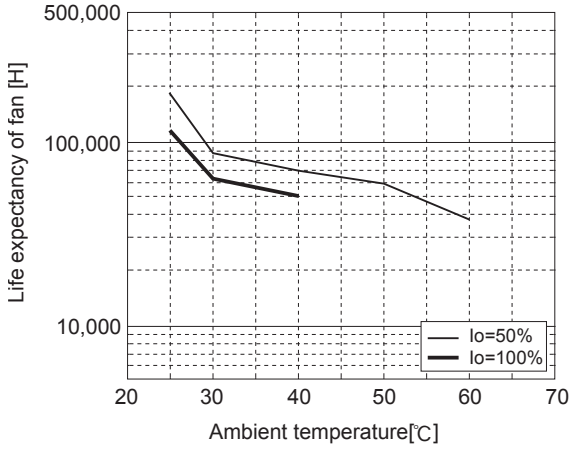


Fig.3.4 Life expectancy of fan of FETA7000T and FETA7000ST

■Warranty

Warranty is 3 years.

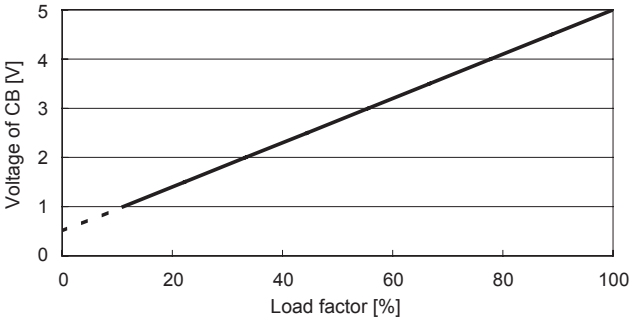
4 Others

4.1 Output Current Monitor

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

■Fig.4.1 shows the relationship between the voltage of the terminal CB and the output current.

The output current shown in Fig.4.1 should be used only as a guide.



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

Fig.4.1 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.

4.2 Auxiliary Power (AUX)

● FETA2500BA, 3000BA, 7000T, 7000ST

■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.

4.3 Output Capacitive Load Considerations

■Please see Table 4.1 for maximum value of external output capacitance.If the external output capacitance exceeds the value shown in Table 4.1, please contact us for details.

Table 4.1 Maximum value of external output capacitance

Model	Maximum value of external output capacitance [μF]
FETA2500BA-36	22,000
FETA2500BA-48	22,000
FETA3000BA-48	22,000
FETA3000BC-250	3,300
FETA7000T-48	22,000
FETA7000T-144	7,500
FETA7000ST-48	22,000
FETA7000ST-144	7,500

4.4 External Component (EMI/EMC Filter)

● FETA2500BA, 3000BA, 3000BC, 7000T

FETA2500BA, FETA3000BA, FETA3000BC and FETA7000T can comply with FCC Part 15 class B and CISPR32-B, EN55032-B, VCCI-B by connecting an external EMI/EMC Filter.

Recommended EMI/EMC Filler :

FETA2500BA, 3000BA, 3000BC: NAC-20-472 (COSEL)

FETA7000T : TAC-30-683 (COSEL)

● FETA7000ST

FETA7000ST can comply with FCC Part 15 class A and CISPR32-A, EN55032-A, VCCI-A by connecting an external EMI/EMC Filter.

Recommended EMI/EMC Filter:

YAC-25-685 (COSEL)

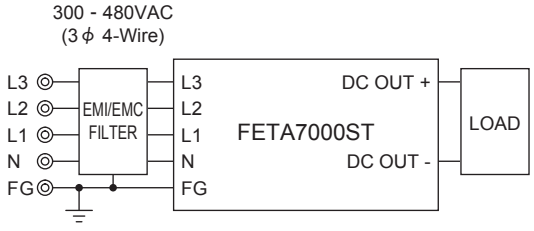


Fig.4.2 Connecting EMI/EMC Filter

4.5 Ground

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

4.6 Variable Speed Fan

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

4.7 Conditions of the safety approval

■To apply for safety standard using this power supply, the following conditions must be met.

①This unit must be used as a component of the end-use equipment.

②This unit must be provided with overall enclosure.

③The FG terminal must be connected to safety ground of the end-use equipment, as required for class I equipment.

④50A circuit breaker must be externally installed on the input side. (FETA7000T, FETA7000ST)

⑤Altitude of operation is up to 3,000 m.

● FETA3000BC

■Table 4.2 shows the ES classes certified by safety standards for the FETA3000BC output terminals, CN1, CN2, and CN3.

Table 4.2 ES class for each terminal and connector (FETA3000BC)

Connector	Pin No.	ES class
+Output		ES3
−Output		
CN1	ALL	
CN2	ALL	
CN3	ALL	ES1

5 Options

5.1 Outline of Options

＊Please inquire for details of specifications and delivery timing.

＊You can combine multiple options. Some options, however, can not be combined with other options. Please contact us for details.

● -R (FETA2500BA, 3000BA, 3000BC)

■Specification with reversed logic for remote ON/OFF operation. Remote ON/OFF specification of Option-R is on Table 5.1 and Table 5.2.

Table 5.1 Remote ON/OFF specification of Option-R (RC-RCG)

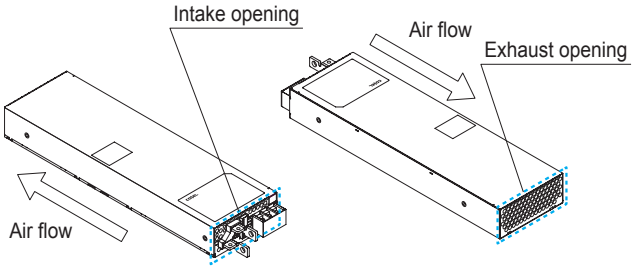
Output Voltage	Between RC and RCG
OFF	L level (0 to 0.5V) or Open
ON	H level (4.5 to 12.5V)

Table 5.2 Remote ON/OFF specification of Option-R (Case of Fig.1.3)

Connection method	Fig.1.3 (a)	Fig.1.3 (b)	Fig.1.3 (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

● -F2 (FETA2500BA)

■Specification with reversed air exhaust.
■Differences from standard products are shown in Fig.5.1 and Fig.5.2.
■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.5.1 Location of intake port and exhaust port

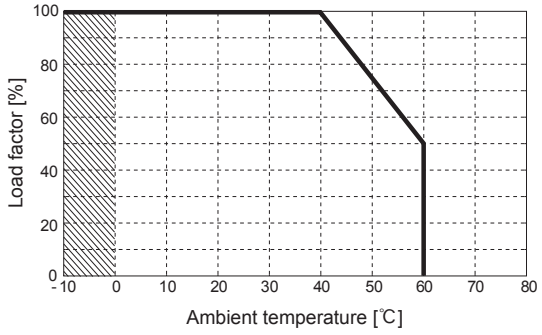


Fig.5.2 Ambient temperature derating curve