# Instruction Manual

## TUNS-Series

### Cosel

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## Basic Characteristics Data

| Model | Circuit method | Switching frequency [kHz] | Input current [A] *1 | Inrush current protection circuit | PCB/Pattern | | | Series/Parallel operation availability | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Material | Single sided | Double sided | Series operation | Parallel operation |
| TUNS50F | Active filter | 80-600 | 0.67 | Thermistor | Aluminum | Yes | | Yes | *2 |
| | Flyback converter | 100-300 | | | | | | | |
| TUNS100F | Active filter | 80-600 | 1.3 | Thermistor | Aluminum | Yes | | Yes | *2 |
| | Forward converter | 300 | | | | | | | |
| TUNS300F | Active filter | 100 | 3.6 | SCR | Aluminum | Yes | | Yes | *2 |
| | Half-bridge converter | 400 | | | | | | | |
| TUNS500F | Active filter | 100 | 6.0 | SCR | Aluminum | Yes | | Yes | *2 |
| | Half-bridge converter | 400 | | | | | | | |
| TUNS700F | Active filter | 100 | 8.6 | SCR | Aluminum | Yes | | Yes | *2 |
| | Half-bridge converter | 400 | | | | | | | |

*1 The value of input current is at ACIN 100V and rated load.
*2 Refer to instruction manual.

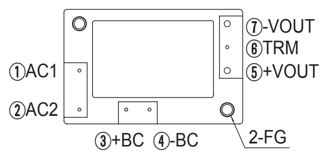
## TUNS50F, TUNS100F



## TUNS300F, TUNS500F, TUNS700F

# 1 Pin Connection

## ●TUNS50F




## ●TUNS100F

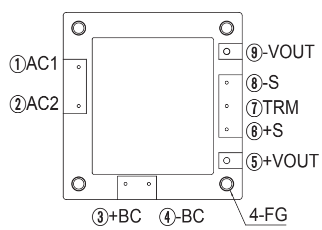



Fig.1.1 Pin connection (bottom view)

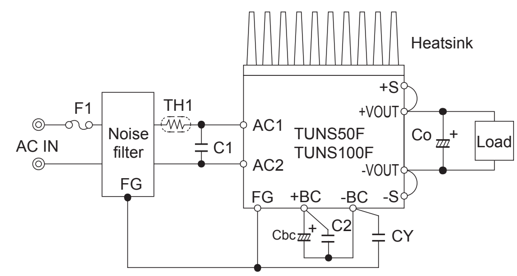
Table 1.1 Pin connection and function

| No. | | Pin Connection | Function |
|---|---|---|---|
| TUNS50F | TUNS100F | | |
| ① | ① | AC1 | AC input |
| ② | ② | AC2 | |
| ③ | ③ | +BC | +BC output |
| ④ | ④ | -BC | -BC output |
| ⑤ | ⑤ | +VOUT | +DC output |
| ⑦ | ⑨ | -VOUT | -DC output |
| - | ⑧ | -S | Remote sensing (-) |
| - | ⑥ | +S | Remote sensing (+) |
| ⑧ | ⑦ | TRM | Adjustment of output voltage |
| - | - | FG | Mounting hole (FG) |

# 2 Connection for Standard Use

■To use TUNS series, connection shown in Fig.2.1 and external components are required.

■This product uses conduction cooling method (e.g. heat radiation from the aluminum base plate to the attached heat sink). Reference: 6.5 "Derating"




+S, -S : TUNS100F

Fig.2.1 Connection for standard use

Table 2.1 External components

| No. | Symbol | Components | Reference |
|---|---|---|---|
| 1 | F1 | Input fuse | 3.1 "Wiring input pin (1)" |
| 2 | C1 | Input Capacitor | 3.1 "Wiring input pin (2)" |
| 3 | – | Noise Filter | 3.1 "Wiring input pin (3)" |
| 4 | CY | Y capacitor | |
| 5 | TH1 | Inrush current protection thermistor | 3.1 "Wiring input pin (4)" |
| 6 | Co | Output capacitor | 3.2 "Wiring output pin (1)" |
| 7 | Cbc | Smoothing Capacitor for boost voltage | 3.3 "Wiring +BC/-BC pins (1)" |
| 8 | C2 | Capacitor for boost voltage | 3.3 "Wiring +BC/-BC pins (2)" |
| 9 | – | Heatsink | 6.6 "Heat sink" |

TUNS

# 3 Wiring Input/Output Pin

## 3.1 Wiring input pin

(1) F1 : External fuse

■Fuse is not built-in on input side. In order to protect the unit, install the slow-blow type fuse on input side (as shown in Table 3.1).

Table 3.1 Recommended fuse (Slow-blow type)

| Model | TUNS50F | TUNS100F |
|---|---|---|
| Rated current | 2A | 3.15A |

(2) C1 : External Capacitor for input side

■Install a film capacitor as input capacitor C1 of which the capacitance and ripple current capability are above the values shown in Table 3.2.

■Use a safety approved capacitor with 250V ac rated voltage.

■If C1 is not connected, it may cause the failure of the power supply or external components.

Table 3.2 Input Capacitor C1

| No. | Model | Voltage | Capacitance | Rated ripple current |
|---|---|---|---|---|
| 1 | TUNS50F | AC250V | 1μF or more | 3A or more |
| 2 | TUNS100F | | 1μF or more | 3A or more |

(3) CY : Noise filter/Decoupling capacitor

■The product doesn't have noise filter internally.
Please connect external noise filter and primary decoupling capacitor CY for low line noise and stable operation of the power supply.

■The operation of the power supply may be unstable due to the resonance of the filter or inductance.

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

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

■When the total capacitance of the primary decoupling capacitor is more than 8800pF, the nominal value in the specification may not be met by the Hi-Pot test between input and output. A capacitor should be installed between output and FG.

(4) TH1 : Inrush current limiting thermistor

■It has a possibility that internal components fail by inrush current, so please use power thermistor or inrush current limiting circuit to keep input current below 60A.

■If you use power thermistor and turn the power ON/OFF repeatedly within a short period of time, please have enough intervals so that a power supply cools down before being turned on. And appropriate intervals should be set even if inrush current limiting circuit except power thermistor is used.

■The output voltage may become unstable at low temperature due to the ESR of power thermistor. In this case, increase the capacitance of Cbc more than recommended value or connect same capacitors in parallel. Please evaluate before use.

## 3.2 Wiring output pin

(1) Co : Output capacitor

■Install an external capacitor Co between +VOUT and -VOUT pins for stable operation of the power supply (Fig.2.1).
Recommended capacitance of Co is shown in Table 3.3.

■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).

■When the power supply is used under 0℃ ambient temperature, output ripple voltage increases. In this case, connect 3 capacitors Co in parallel connection.

Table 3.3 Recommended capacitance Co[μF]

| Model / Output voltage (V) | Temperature of base plate Tc=0 to +100℃ | | Tc=-40 to +100℃ | |
|---|---|---|---|---|
| | TUNS50F | TUNS100F | TUNS50F | TUNS100F |
| 5 | 2200 | 2200 | 2200×3 | 2200×3 |
| 12 | 470 | 470 | 470×3 | 470×3 |
| 24 | 220 | 220 | 220×3 | 220×3 |

The specified ripple and ripple noise are measured by the method introduced in Fig.3.1.

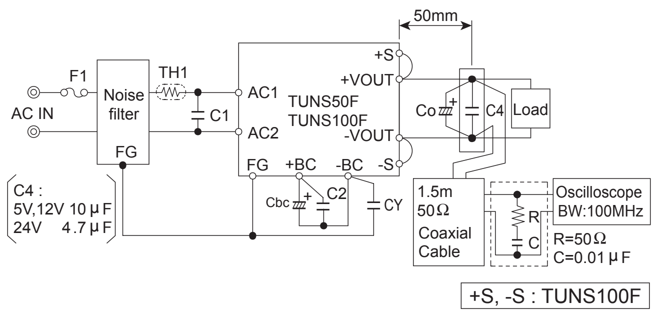



Fig.3.1 Method of Measuring Output Ripple and Ripple Noise

## 3.3 Wiring +BC/-BC pins

(1) Cbc : Smoothing capacitor for boost voltage

■In order to smooth boost voltage, connect Cbc between +BC and -BC. Recommended capacitance of Cbc is shown in Table3.4.

■Note that +BC and -BC terminals have high voltage (DC385V typ).

■Keep the capacitance within the allowable external capacitance.

■Select a capacitor of which the boost voltage ripple voltage does not exceed 30Vp-p.

■When the power supply is operated under -20℃, it may make the boost voltage unstable due to the characteristic of equivalent series resistor. Please choose the capacitor which has more than recommended capacitance.

Table 3.4 Recommended capacitance Cbc

| No. | Model | Voltage | Cbc | Allowable capacitance range |
|---|---|---|---|---|
| 1 | TUNS50F | DC420V or more | 82μF | 47 to 150μF |
| 2 | TUNS100F | | 120μF | 68 to 220μF |

(2) C2 : Capacitor for boost voltage

■Install external capacitors C2 with capacitance shown in table 3.5.
■If capacitors C2 are not installed, it may cause the failure of the power supply or external components.

Table 3.5 Recommended capacitance C2

| No. | Model | Voltage | Capacitance | Rated ripple current |
|---|---|---|---|---|
| 1 | TUNS50F | DC450V | 0.47μF or more | 1A or more |
| 2 | TUNS100F | | 0.47μF or more | 1A or more |

# 4 Function

## 4.1 Input voltage range

■The input voltage range is from 85 VAC to 264 VAC.
■In cases that conform with safety standard, input voltage range is AC100-AC240V(50/60Hz).
■Be aware that use of voltages other than those listed above may result in the unit not operating according to specifications, or may cause damage. Avoid square waveform input voltage, commonly used in UPS units and inverters.

## 4.2 Overcurrent protection

■Overcurrent protection is built-in and comes into effect at 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 intermittent operation of power supply.

## 4.3 Overvoltage protection

■Overvoltage protection circuit is built-in. If the overvoltage protection circuit is activated, shut down the input voltage, wait more than 3 minutes and turn on the AC input again to recover the output voltage. Recovery time varies depending on such factors as input voltage value at the time of the operation.

Remarks:
Please note that devices inside the power supply might fail when voltage of 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.
To check the function of overvoltage protection, adjust the output voltage by changing TRM voltage. Please contact us for details.

## 4.4 Thermal protection

■When the power supply temperature is kept above 100℃, the thermal protection will be activated and simultaneously shut down the output.
When the thermal protection is activated, shut off the input voltage and eliminate all the overheating conditions. To recover the output voltage, keep enough time to cool down the power supply before turning on the input voltage again.

## 4.5 Remote sensing

### ●TUNS50F

■Remote sensing is not built-in.

### ●TUNS100F

■Remote sensing is built-in.
(1) When the remote sensing function is not in use

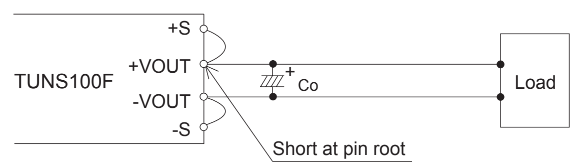



Fig. 4.1 Connection when the remote sensing is not in use

■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

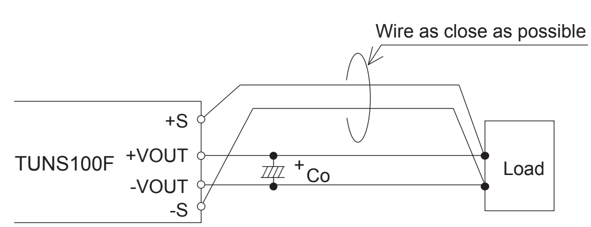



Fig. 4.2 Connection when the remote sensing is in use

■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.

■As wiring or load impedance may generate oscillation or large fluctuations in output voltage, make sure enough evaluation is given advance.

## 4.6 Adjustable voltage range

■Output voltage between +VOUT and -VOUT can be adjusted by connecting external resistors to TRM.

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

■When the output voltage adjustment is used, note that the over-voltage protection circuit operates when output voltage is set too high.

■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:

Resistors············ Metal film type, coefficient less than ±100ppm/℃

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

■Output voltage can be adjusted by connecting an external potentiometer (VR1) and resistors (R1 and R2) as shown in Fig. 4.3. Output voltage will increase if the resistance between ② and ③ is reduced by turning the potentiometer. Recommended values for external components are shown in Table 4.1. Consult us if the power module is used in a different configuration.

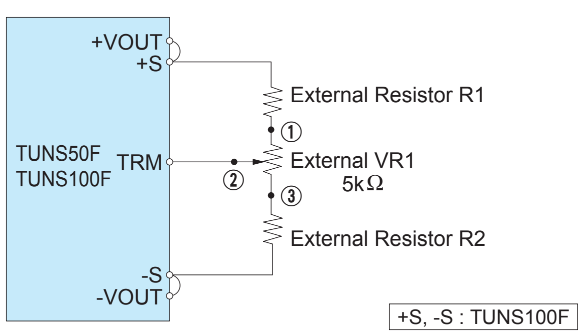



Fig. 4.3 Connecting External Devices (TUNS50F/TUNS100F)

Table 4.1 Recommended Values of External Resistors (TUNS50F, TUNS100F)

| No. | Output Voltage | Adjustable Range | | | |
|---|---|---|---|---|---|
| | | VOUT±5% | | VOUT±10% | |
| | | R1 | R2 | R1 | R2 |
| 1 | 5V | 10kΩ | 2.7kΩ | 4.7kΩ | 1kΩ |
| 2 | 12V | 12kΩ | 2.2kΩ | 5.6kΩ | 560Ω |
| 3 | 24V | 27kΩ | 1.8kΩ | 15kΩ | 470Ω |

## 4.7 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.

# 5 Series and Parallel Operation

## 5.1 Series operation

■Series operation is available by connecting the outputs of two or more power supplies as shown below. Output current in series connection should be lower than the lowest rated current in each unit.

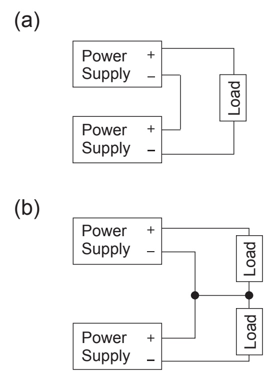



Fig. 5.1 Examples of series operation

## 5.2 Parallel operation

■Parallel operation is not possible.

■Redundancy operation is available by wiring as shown below.

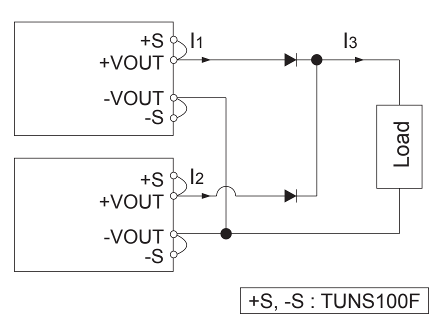



Fig. 5.2 Example of Redundancy Operation

■Even a slight difference in output voltage can affect the balance between the values of $I_1$ and $I_2$. Please make sure that the value of $I_3$ does not exceed the rated current of a power supply.

$I_3 \leqq$ the rated current value

# 6 Implementation・Mounting Method

## 6.1 Mounting method

■The unit can be mounted in any direction. When two or more power supplies are used side by side, position them with proper intervals to allow enough air ventilation. Aluminum base plate temperature of each power supply should not exceed the temperature range shown in derating curve.

■Avoid placing the AC input line pattern layout underneath the unit. It will increase the line conducted noise. Make sure to leave an ample distance between the line pattern layout and the unit. Also avoid placing the DC output line pattern underneath the unit because it may increase the output noise. Lay out the pattern away from the unit.

■Avoid placing the signal line pattern layout underneath the unit because the power supply might become unstable. Lay out the pattern away from the unit.

■High-frequency noise radiates directly from the unit to the atmosphere. Therefore, design the shield pattern on the printed circuit board and connect it to FG.
The shield pattern prevents noise radiation.

■When a heat sink cannot be fixed on the base plate side, order the power module with "-T" option. A heat sink can be mounted by affixing a M3 tap on the heat sink.
Please make sure a mounting hole will be connected to a grounding capacitor $C_Y$.

Table 6.1 Mounting Hole Configuration

| | Mounting hole |
|---|---|
| Standard | M3 tapped |
| Optional : -T | ϕ3.4 thru |

## 6.2 Stress to the pins

■When too much stress is applied to the pins may damage internal connections. Avoid applying stress in excess of that shown in Fig. 6.1.

■The pins are soldered onto the internal PCB.
Therefore, Do not bend or pull the leads with excessive force.

■Mounting hole diameter of PCB should be 3.5mm to reduce the stress to the pins.

■Fix the unit on PCB (fixing fittings) by screws to reduce the stress to the pins. Be sure to mount the unit first, then solder the unit.

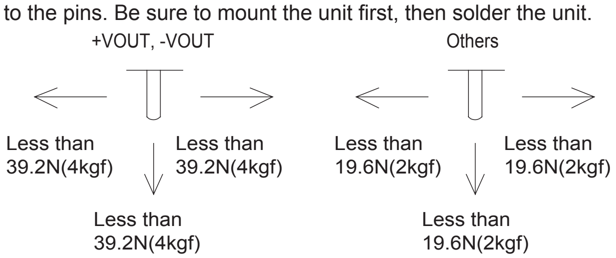



Fig. 6.1 Stress to the pins

## 6.3 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.

## 6.4 Soldering temperature

■Flow soldering: 260℃ for up to 15 seconds.

■Soldering iron (26W): 450℃ for up to 5 seconds.

## 6.5 Derating

(1) Input voltage derating curve
Input voltage derating curve is shown in Fig.6.2.

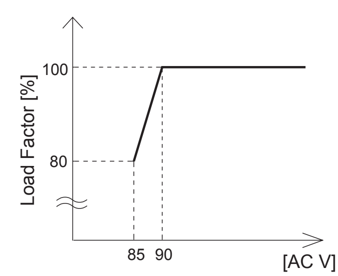



Fig. 6.2 Input voltage derating curve

(2) Output voltage derating curve

■Use the power modules with conduction cooling (e.g. heat dissipation from the aluminum base plate to the attached heat sink).
Fig. 6.3 shows the derating curves with respect to the aluminum base plate temperature. Note that operation within the hatched areas will cause a significant level of ripple and ripple noise.

■Please measure the temperature on the aluminum base plate edge side when you cannot measure the temperature of the center part of the aluminum base plate.
In this case, please take 5deg temperature margin from the derating characteristics shown in Fig.6.3.
Please reduce the temperature fluctuation range as much as possible when the up and down of the temperature are frequently generated.
Contact us for more information on cooling methods.

TUNS

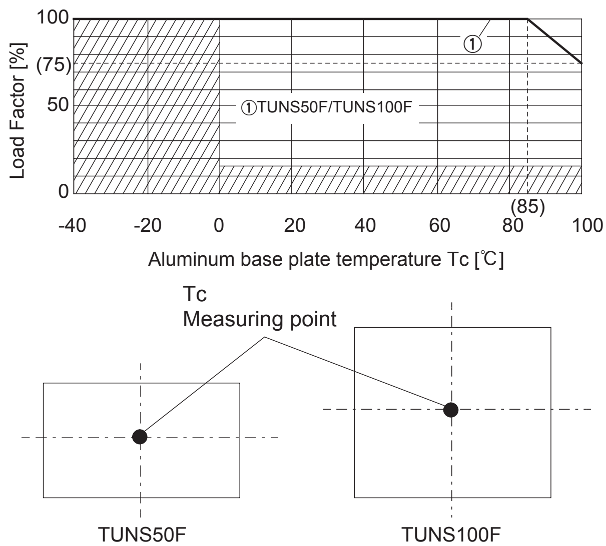



Fig.6.3 Derating curve

## 6.6 Heat sink (Optional parts)

■The power module works with conduction cooling and needs heat dissipation using heat sinks. Optional heat sinks are available for TUNS50F/TUNS100F Series. Refer to Table 6.1 and Table 6.2 for details on the thermal resistance of heat sinks.

### ●TUNS50F

Table 6.1 Types of Heat Sinks Available

| No. | Model | Size[mm] | | | Thermal resistance[℃/W] | | Style |
|---|---|---|---|---|---|---|---|
| | | H | W | D | Convection (0.1m/s) | Forced Air | |
| 1 | F-QB-F1 | 12.7 | 58.4 | 37.6 | 14.0 | Refer Fig.6.5 | Horizontal |
| 2 | F-QB-F2 | 12.7 | 58.7 | 37.3 | | | Vertical |
| 3 | F-QB-F3 | 25.4 | 58.4 | 37.6 | 7.5 | | Horizontal |
| 4 | F-QB-F4 | 25.4 | 58.7 | 37.3 | | | Vertical |
| 5 | F-QB-F5 | 38.1 | 58.4 | 37.6 | 5.0 | | Horizontal |
| 6 | F-QB-F6 | 38.1 | 58.7 | 37.3 | | | Vertical |

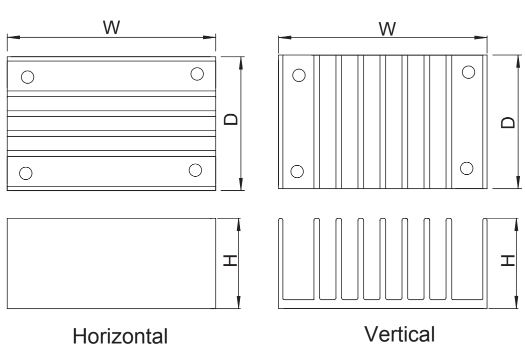



Fig.6.4 Heat Sink Types

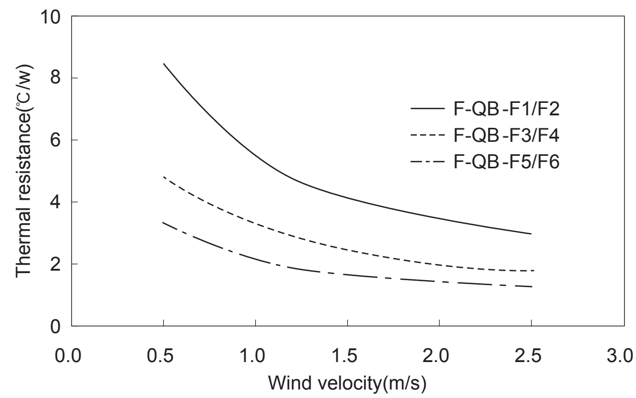



Fig.6.5 Thermal Resistance of Heat Sink(Forced Air)

### ●TUNS100F

Table 6.2 Types of Heat Sinks Available

| No. | Model | Size[mm] | | | Thermal resistance[℃/W] | | Style |
|---|---|---|---|---|---|---|---|
| | | H | W | D | Convection (0.1m/s) | Forced Air | |
| 1 | F-CBS-F1 | 12.7 | 57.9 | 61.5 | 7.5 | Refer Fig.6.7 | Horizontal |
| 2 | F-CBS-F2 | 12.7 | 58.4 | 61.0 | | | Vertical |
| 3 | F-CBS-F3 | 25.4 | 57.9 | 61.5 | 4.6 | | Horizontal |
| 4 | F-CBS-F4 | 25.4 | 58.4 | 61.0 | | | Vertical |
| 5 | F-CBS-F5 | 38.1 | 57.9 | 61.5 | 3.0 | | Horizontal |
| 6 | F-CBS-F6 | 38.1 | 58.4 | 61.0 | | | Vertical |

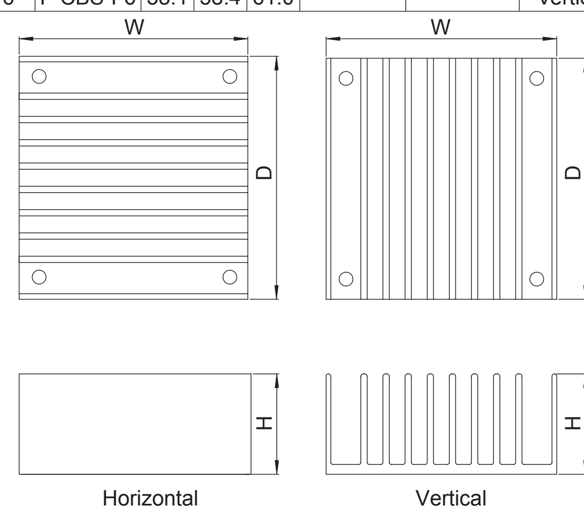



Fig. 6.6 Heat Sink Types

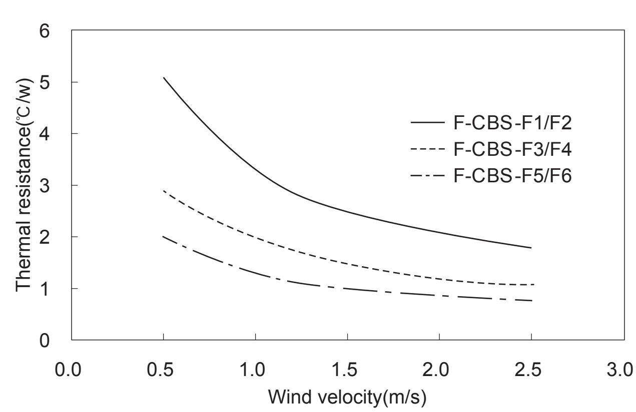



Fig.6.7 Thermal Resistance of Heat Sink(Forced Air)

# 7 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.7.1.
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.

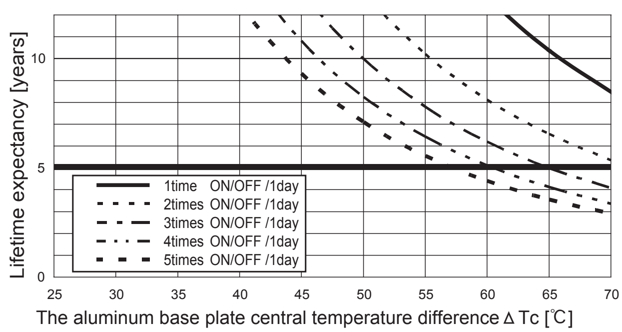



Fig.7.1 Lifetime expectancy against rise/fall temperature difference

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

# 1 Pin Connection

## ●TUNS300F/TUNS500F/TUNS700F

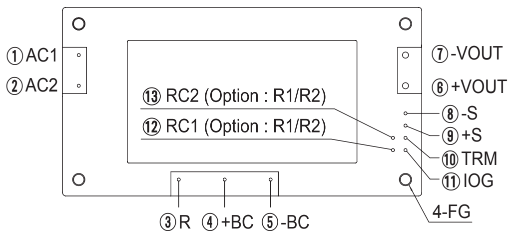



Fig.1.1 Pin connection (bottom view)

Table 1.1 Pin connection and function

| No. | Pin Connection | Function |
|---|---|---|
| ① | AC1 | AC input |
| ② | AC2 | |
| ③ | R | External resistor for inrush current protection |
| ④ | +BC | +BC output |
| ⑤ | –BC | –BC output |
| ⑥ | +VOUT | +DC output |
| ⑦ | –VOUT | –DC output |
| ⑧ | –S | Remote sensing (–) |
| ⑨ | +S | Remote sensing (+) |
| ⑩ | TRM | Adjustment of output voltage |
| ⑪ | IOG | Inverter operation monitor |
| ⑫ | RC1 | Remote ON/OFF (Option) |
| ⑬ | RC2 | |
| – | FG | Mounting hole (FG) |

## ●TUNS700F□□-P (OPTION)

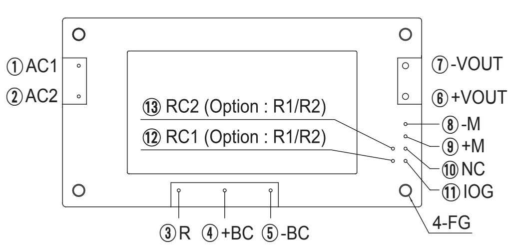



Fig.1.2 Pin connection (bottom view)

Table 1.2 Pin connection and function

| No. | Pin Connection | Function |
|---|---|---|
| ⑧ | –M | Output voltage monitor terminal |
| ⑨ | +M | |
| ⑩ | NC | No connection |

Other than the above are the same as standard products.
Please refer to Table 1.1.

# 2 Connection for Standard Use

■To use TUNS series, connection shown in Fig.2.1 and external components are required.

■This product uses conduction cooling method (e.g. heat radiation from the aluminum base plate to the attached heat sink).
Reference: 6.5 "Derating"

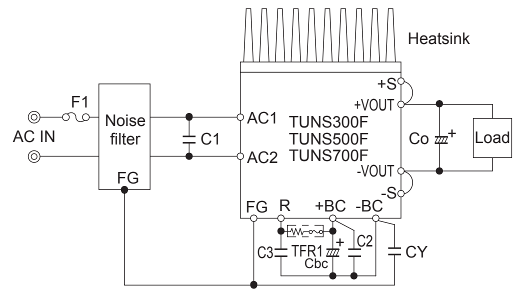



Fig.2.1 Connection for standard use

Table 2.1 External components

| No. | Symbol | Components | Reference |
|---|---|---|---|
| 1 | F1 | Input fuse | 3.1 "Wiring input pin (1)" |
| 2 | C1 | Input Capacitor | 3.1 "Wiring input pin (2)" |
| 3 | – | Noise Filter | 3.1 "Wiring input pin (3)" |
| 4 | CY | Y capacitor | |
| 5 | Co | Output capacitor | 3.2 "Wiring output pin (1)" |
| 6 | Cbc | Smoothing Capacitor for boost voltage | 3.3 "+BC/-BC pins (1)" |
| 7 | C2,C3 | Capacitor for boost voltage | 3.3 "+BC/-BC pins (2)" |
| 8 | TFR1 | Inrush current protection resistor | 3.3 "+BC/-BC pins (3)" |
| 9 | – | Heatsink | – |

# 3 Wiring Input/Output Pin

## 3.1 Wiring input pin

(1) F1 : External fuse

■Fuse is not built-in on input side. In order to protect the unit, install the slow-blow type fuse on input side (as shown in Table 3.1).

Table 3.1 Recommended fuse (Slow-blow type)

| Model | TUNS300F | TUNS500F/TUNS700F |
|---|---|---|
| Rated current | 10A | 15A |

(2) C1 : External Capacitor for input side

■Install a film capacitor as input capacitor C1 of which the capacitance and ripple current capability are above the values shown in Table 3.2.
■Use a safety approved capacitor with 250V ac rated voltage.
■If C1 is not connected, it may cause the failure of the power supply or external components.

Table 3.2 Input Capacitor C1

| No. | Model | Voltage | Capacitance | Rated ripple current |
|---|---|---|---|---|
| 1 | TUNS300F | AC250V | 2μF or more | 5A or more |
| 2 | TUNS500F | | 2μF or more | 5A or more |
| 3 | TUNS700F | | 3μF or more | 5A or more |

(3) CY : Noise filter/Decoupling capacitor

■The product doesn't have noise filter internally.
Please connect external noise filter and primary decoupling capacitor CY for low line noise and stable operation of the power supply.
■The operation of the power supply may be unstable due to the resonance of the filter or inductance.
■Install a correspondence filter, if it is required to meet a noise standard or if the surge voltage may be applied to the unit.
■Install a primary decoupling capacitor CY, with more than 470pF, near the input pins (within 50mm from the pins).
■When the total capacitance of the primary decoupling capacitor is more than 8800pF, the nominal value in the specification may not be met by the Hi-Pot test between input and output. A capacitor should be installed between output and FG.



## 3.2 Wiring output pin

(1) Co : Output capacitor

■Install an external capacitor Co between +VOUT and -VOUT pins for stable operation of the power supply (Fig.2.1).
Recommended capacitance of Co is shown in Table 3.3.
■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).
■When the power supply is used under 0℃ ambient temperature, output ripple voltage increases. In this case, connect 3 capacitors Co in parallel connection.

Table 3.3 Recommended capacitance Co[μF]

| Model / Output voltage (V) | Temperature of base plate | |
|---|---|---|
| | Tc=0 to +100℃ | Tc=-40 to +100℃ |
| | TUNS300F/TUNS500F TUNS700F | TUNS300F/TUNS500F TUNS700F |
| 12 | 2200 | 2200×3 |
| 28 | 1000 | 1000×3 |
| 48 | 470 | 470×3 |

The specified ripple and ripple noise are measured by the method introduced in Fig.3.1.

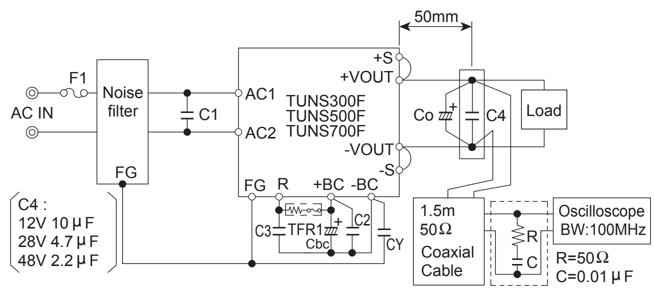



Fig.3.1 Method of Measuring Output Ripple and Ripple Noise

## 3.3 Wiring +BC/-BC pins

(1) Cbc : Smoothing capacitor for boost voltage

■In order to smooth boost voltage, connect Cbc between +BC and -BC. Recommended capacitance of Cbc is shown in Table3.4.
■Note that +BC and -BC terminals have high voltage (DC380V typ).
■Keep the capacitance within the allowable external capacitance.
■Select a capacitor of which the boost voltage ripple voltage does not exceed 30Vp-p.
■When the power supply is operated under -20℃, it may make the boost voltage unstable due to the characteristic of equivalent series resistor. Please choose the capacitor which has more than recommended capacitance.

Table 3.4 Recommended capacitance Cbc

| No. | Model | Voltage | Cbc | Allowable capacitance range |
|---|---|---|---|---|
| 1 | TUNS300F | DC420V or more | 470μF | 390 to 2200μF |
| 2 | TUNS500F | | 390μF×2 | 390 to 2200μF |
| 3 | TUNS700F | | 390μF×2 | 470 to 2200μF |

(2) C2, C3 : Capacitor for boost voltage

■Install external capacitors C2, C3 with capacitance shown in table 3.5.
■If capacitors C2, C3 are not installed, it may cause the failure of the power supply or external components.

Table 3.5 Recommended capacitance C2 and C3

| No. | Model | Voltage | Capacitance | Rated ripple current |
|---|---|---|---|---|
| 1 | TUNS300F | DC450V | 1μF or more | 3A or more |
| 2 | TUNS500F | | 1μF or more | 3A or more |
| 3 | TUNS700F | | 1μF or more | 3A or more |

(3) TFR1 : Inrush current limiting resistor 4.7ohm - 22ohm

■Connect a resistor between R pin and +BC pin for inrush current protection. The surge capacity is required for TFR1, please contact component mfg. Wirewound resistor with thermal cut-offs type is required.

# 4 Function

## 4.1 Input voltage range

■The input voltage range is from 85 VAC to 264 VAC.
■In cases that conform with safety standard, input voltage range is AC100-AC240V(50/60Hz).
■Be aware that use of voltages other than those listed above may result in the unit not operating according to specifications, or may cause damage. Avoid square waveform input voltage, commonly used in UPS units and inverters.

## 4.2 Overcurrent protection

### ●TUNS300F/TUNS700F

■Overcurrent protection is built-in and comes into effect at 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 intermittent operation of power supply.

### ●TUNS500F

■Overcurrent protection is built-in and comes into effect at over 101% of the peak 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 intermittent operation of power supply.

## 4.3 Peak current protection

### ●TUNS500F

■Peak current protection is built-in. When the power supply is operated at over peak load based on section 7 (Peak current), this function comes into effect and reduce the output.
■A few seconds later, a unit automatically recovers. But if the overcurrent condition has not been released, the output will reduced again (intermittent operation mode).

## 4.4 Overvoltage protection

■Overvoltage protection circuit is built-in. If the overvoltage protection circuit is activated, shut down the input voltage, wait more than 3 minutes and turn on the AC input again to recover the output voltage. Recovery time varies depending on such factors as input voltage value at the time of the operation.

Remarks:
Please note that devices inside the power supply might fail when voltage of 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.

## 4.5 Thermal protection

■When it exceeds the Derating (Section 6.5), the thermal protection will be activated and simultaneously shut down the output.
When the thermal protection is activated, shut off the input voltage and eliminate all the overheating conditions. To recover the output voltage, keep enough time to cool down the power supply before turning on the input voltage again.

## 4.6 Remote ON/OFF

### ●-R1

■Remote ON/OFF is possible by applying a voltage between RC1 and RC2 pin. External DC power source is necessary to operate remote control.
External current limiting resistor Rrc is necessary.
■When power supply shut off by over voltage protection or overheating protection, it can be recovered by toggling Remote ON/OFF signal.

Table .4.1 Remote ON/OFF connection specification

| No. | ITEM | RC1, RC2 |
|---|---|---|
| 1 | Function | Output is OFF in "L" |
| 2 | Base pin | RC2 |
| 3 | Output ON | SW OPEN<br>(0.5V max, 0.1mA max) |
| 4 | Output OFF | SW SHORT<br>(5mA typ, 3mA min) |

■Sink current of RC1 must be kept up to 12mA.

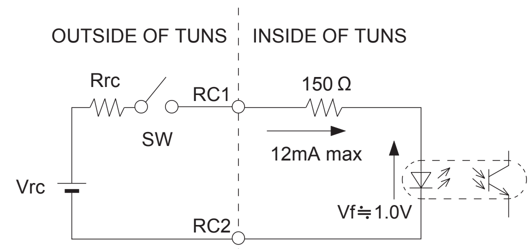



Fig .4.1 RC Connection Example

＊Please be careful not to connect RC1 and RC2 opposite.
It may cause a failure of power supply.
■Remote ON/OFF circuit (RC1, RC2) is isolated from the input and output and FG.

### ●-R2

■"-R2" can reduce standby power than "-R1".
■The usage is same as option "-R1".
Please refer to option "-R1"
▪Standby power
0.5Wtyp (AC100V), 1.2Wtyp (AC200V)

## 4.7 Remote sensing

■Remote sensing is built-in.

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

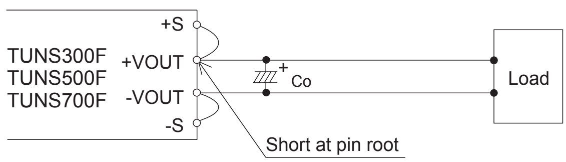



Fig. 4.2 Connection when the remote sensing is not in use

■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

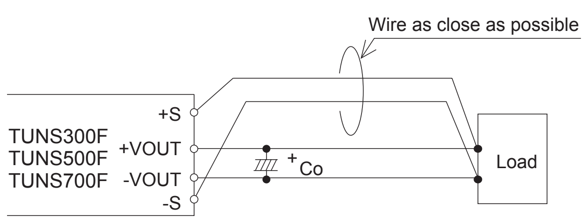



Fig. 4.3 Connection when the remote sensing is in use

■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.

■As wiring or load impedance may generate oscillation or large fluctuations in output voltage, make sure enough evaluation is given advance.

## 4.8 Adjustable voltage range

■Output voltage between +VOUT and -VOUT can be adjusted by connecting external resistors to TRM.

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

■When the output voltage adjustment is used, note that the overvoltage protection circuit operates when output voltage is set too high.

■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:
Resistors············ Metal film type, coefficient less than ±100ppm/℃
Potentiometers ··· Cermet type, coefficient less than ±300ppm/℃

■Output voltage can be adjusted by connecting an external potentiometer (VR1) and resistors (R1 and R2) as shown in Fig. 4.4.
Output voltage will increase if the resistance between ② and ③ is reduced by turning the potentiometer.
Recommended values for external components are shown in Table 4.2.
Consult us if the power module is used in a different configuration.

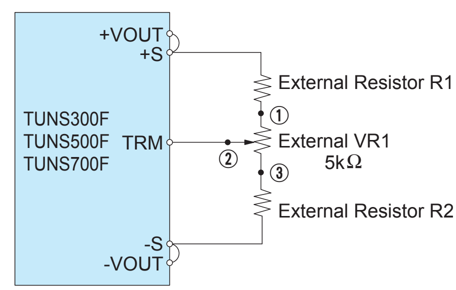



Fig. 4.4 Connecting External Devices (TUNS300F/TUNS500F/TUNS700F)

Table 4.2 Recommended Values of External Resistors (TUNS300F/TUNS500F/TUNS700F)

| No. | Output Voltage | Adjustable Range | | | |
|---|---|---|---|---|---|
| | | VOUT±5% | | VOUT±10% | |
| | | R1 | R2 | R1 | R2 |
| 1 | 12V | 12kΩ | 2.2kΩ | 6.8kΩ | 1.0kΩ |
| 2 | 28V | 39kΩ | | 27kΩ | |
| 3 | 48V | 68kΩ | | 47kΩ | |

### ●-Y1

■Adjustable voltage range of 48V output is changed to ± 20%.

＊Adjustable voltage range of standard type except 48V output is ±20%.

■Safety standard, is considered as Non-SELV output.

## 4.9 Inverter operation monitor (IOG)

■By using the inverter operation monitor (IOG), condition of the inverter can be monitored.

The following ① or ② conditions make the IOG signal turns “H” from “L” within 1 second.

① Malfunction of inverter

② Output voltage is rapidly dropped by adjusting output voltage

Specification of IOG is shown in Table 4.3.

Table 4.3 Specification of IOG

| No. | Item | IOG |
|---|---|---|
| 1 | Function | Normal operation "L" |
| | | Malfunction of inverter "H" |
| 2 | Base pin | -S |
| 3 | Level voltage "L" | 0.5V max at 10mA |
| 4 | Level voltage "H" | Open corrector |
| 5 | Maximum sink current | 10mA max |
| 6 | Maximum applied voltage | 35V max |

## 4.10 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.

# 5 Series and Parallel Operation

## 5.1 Series operation

■Series operation is available by connecting the outputs of two or more power supplies as shown below. Output current in series connection should be lower than the lowest rated current in each unit.

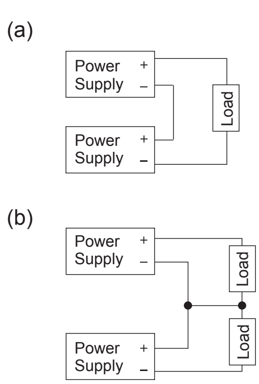



Fig. 5.1 Examples of series operation

## 5.2 Parallel operation

■Parallel operation is not possible.

### ● –P (TUNS700F)

■This option is for parallel operation.

■Sensing and adjustment of the output voltage are not possible at the time of the use with this option.

■As variance of output current drew from each power supply is maximum 10%, the total output current must not exceed the value determined by the following equation.

(Output current in parallel operation)
=(the rated current per unit) x (number of unit) x0.9

Total number of units should be no more than 5 pieces.

■To improve the load sharing of each unit, please use the same length from each unit to the load.

■Connect each input pin for the lowest possible impedance.

When the number of the units in parallel operation increases, input current increases. Adequate wiring design for input circuitry such as circuit pattern, wiring and current for equipment is required.

■If temperatures of aluminum base plates are different in the power supply for parallel operation, values of output current will change greatly.

Design radiation to equalize plate temperatures by attaching the same heatsinks.

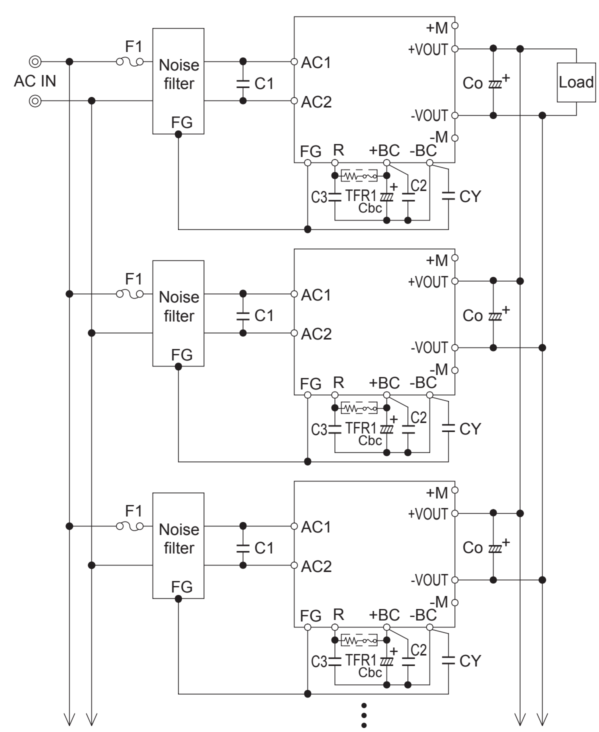



Fig. 5.2 Parallel operation

■Please refer to the application manuals for details of -P type. Application manual is on our web site.

## 5.3 N+1 redundant operation

■Redundancy operation is available by wiring as shown below.

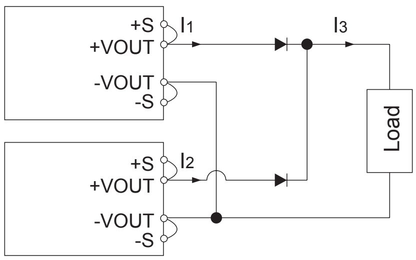



Fig. 5.3 Example of Redundancy Operation

■Even a slight difference in output voltage can affect the balance between the values of $I_1$ and $I_2$.
Please make sure that the value of $I_3$ does not exceed the rated current of a power supply.

$I_3 \leqq$ the rated current value

# 6 Implementation・Mounting Method

## 6.1 Mounting method

■The unit can be mounted in any direction. When two or more power supplies are used side by side, position them with proper intervals to allow enough air ventilation. Aluminum base plate temperature of each power supply should not exceed the temperature range shown in derating curve.

■Avoid placing the AC input line pattern layout underneath the unit. It will increase the line conducted noise. Make sure to leave an ample distance between the line pattern layout and the unit. Also avoid placing the DC output line pattern underneath the unit because it may increase the output noise. Lay out the pattern away from the unit.

■Avoid placing the signal line pattern layout underneath the unit because the power supply might become unstable. Lay out the pattern away from the unit.

■High-frequency noise radiates directly from the unit to the atmosphere. Therefore, design the shield pattern on the printed circuit board and connect it to FG.
The shield pattern prevents noise radiation.

■When a heat sink cannot be fixed on the base plate side, order the power module with "-T" option. A heat sink can be mounted by affixing a M3 tap on the heat sink.
Please make sure a mounting hole will be connected to a grounding capacitor $C_Y$.

Table 6.1 Mounting Hole Configuration

| | Mounting hole |
|---|---|
| Standard | M3 tapped |
| Optional : -T | ϕ3.4 thru |

## 6.2 Stress to the pins

■When too much stress is applied to the pins may damage internal connections. Avoid applying stress in excess of that shown in Fig. 6.1.

■The pins are soldered onto the internal PCB.
Therefore, Do not bend or pull the leads with excessive force.

■Mounting hole diameter of PCB should be 3.5mm to reduce the stress to the pins.

■Fix the unit on PCB (fixing fittings) by screws to reduce the stress to the pins. Be sure to mount the unit first, then solder the unit.

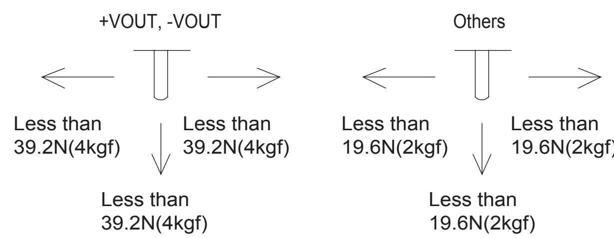



Fig. 6.1 Stress to the pins

## 6.3 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.

## 6.4 Soldering temperature

■Flow soldering: 260℃ for up to 15 seconds.

■Soldering iron (26W): 450℃ for up to 5 seconds.

## 6.5 Derating

(1) Intput voltage derating curve

### ●TUNS700F

■Input voltage derating curve is shown in Fig.6.2.

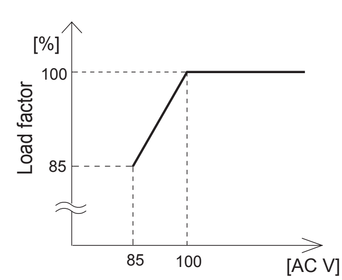



Fig. 6.2 Input voltage derating curve

TUNS

(2) Output voltage derating curve

■Use the power modules with conduction cooling (e.g. heat dissipation from the aluminum base plate to the attached heat sink).
Fig.6.3 shows the derating curves with respect to the aluminum base plate temperature. Note that operation within the hatched areas will cause a significant level of ripple and ripple noise.

■Please measure the temperature on the aluminum base plate edge side when you cannot measure the temperature of the center part of the aluminum base plate.
In this case, please take 5deg temperature margin from the derating characteristics shown in Fig.6.3.

■In case of forced air cooling, please measure the temperature on the leeward side of aluminum base plate edge.
Especially, in case of using small heat sink, the temperature difference between the center and the edge side of the baseplate becomes large.
In this case, 5deg temperature margin is not required.

■Please reduce the temperature fluctuation range as much as possible when the up and down of the temperature are frequently generated.
Contact us for more information on cooling methods.

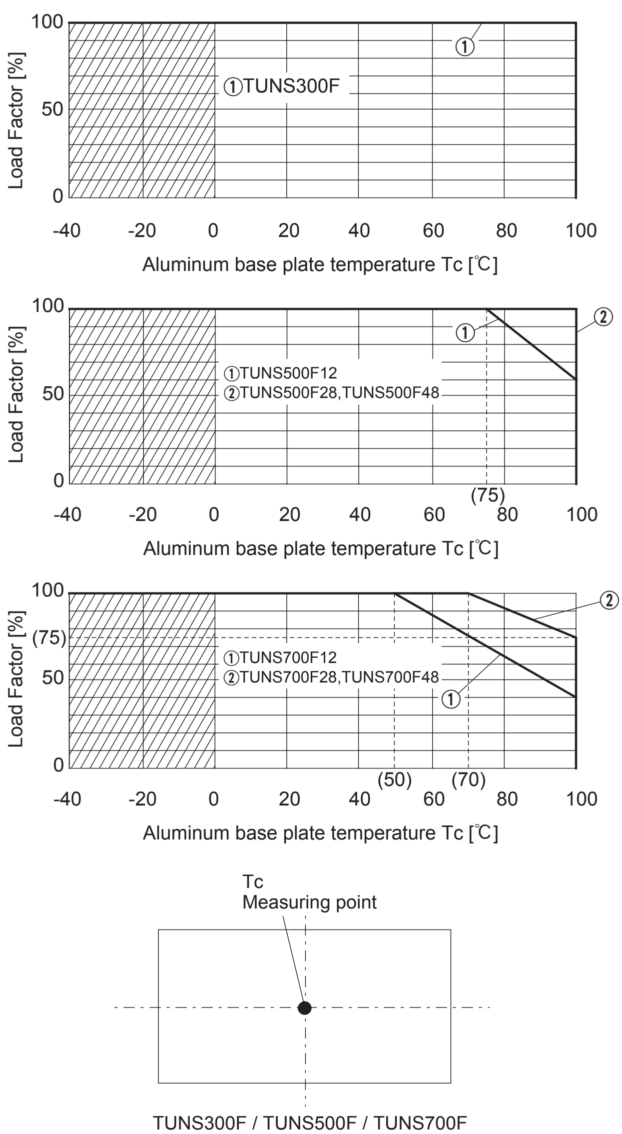



Fig.6.3 Derating curve

# 7 Peak current

## ●TUNS500F

■The unit can generate the peak current under the following conditions.

・t1≦10[sec]
・Ip≦Rated peak current
・Iave≦Rated current
・Duty=t1/ (t1+t2) x 100[%] ≦35%

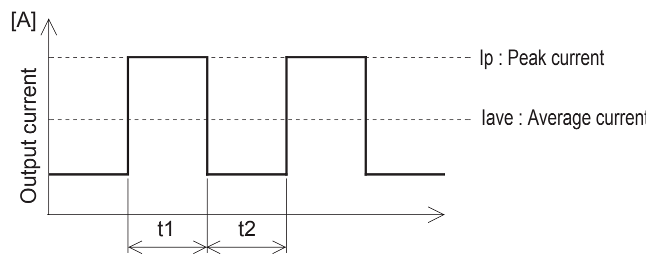



Fig. 7.1 Peak current

■When aluminum baseplate temperature Tc is higher than 95℃, Iave must be less than 95% of rated current. (TUNS500F28 and TUNS500F48)

# 8 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 ($\Delta$Tc) and number of cycling in a day is shown in Fig.8.1.
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.

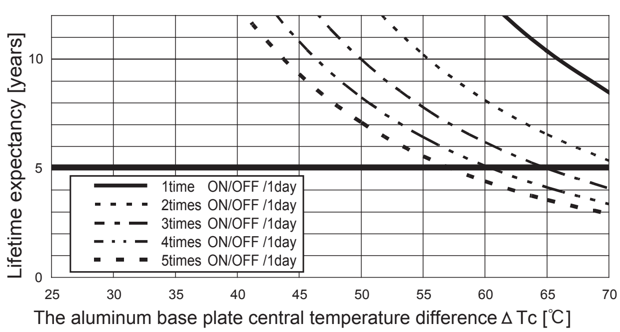





Fig.8.1 Lifetime expectancy against rise/fall temperature difference

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

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