1 Connection for Standard Use

■To use TEPS series, connection shown in Fig.1.1.

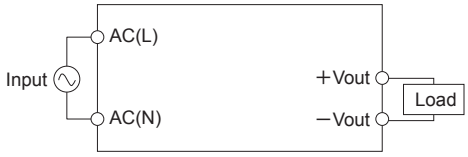


Fig.1.1 Connection for standard use

2 Wiring Input/Output Pin

■The TEPS series basically does not require an output capacitor, but the ripple voltage can be reduced by connecting an output capacitor.

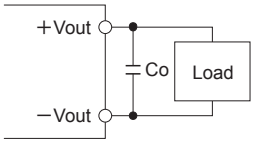


Fig.2.1 Connecting example of an external capacitor to the output side

■If output current decreases rapidly, output voltage rises transiently and the overvoltage protection circuit may operate.In this case, please Install an external capacitor Co between +Vout and -Vout pins for stable operation of the power supply.

■Connectable external capacitor on the output side is shown in Table 2.1 - Table 2.2.

Table 2.1 Connectable external capacitor on the output side (TEPS10F/20F)

No.	Output voltage	TEPS10F/TEPS20F
1	5V	0 - 6,800μF
2	12V	0 - 4,700μF
3	15V	0 - 3,300μF
4	24V	0 - 1,000μF

Table 2.2 Connectable external capacitor on the output side (TEPS45F/65F)

No.	Output voltage	TEPS45F/TEPS65F
1	5V	0 - 6,800μF
2	12V	0 - 4,700μF
3	24V	0 - 1,000μF

■When connect the output to FG of an equipment, a noise may become big. The noise can be reduced by connecting external filter and/or grounding capacitor on the input side.

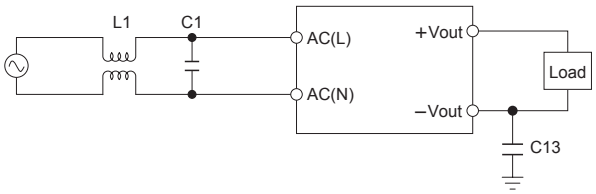


Fig.2.2 Recommended circuit of connect output to FG (TEPS10F/20F)

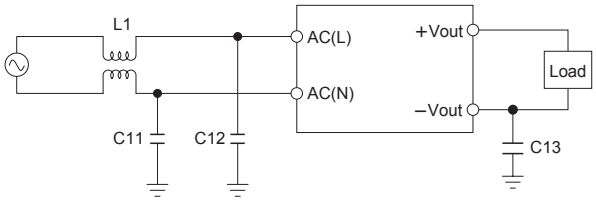


Fig.2.3 Recommended circuit of connect output to FG (TEPS45F/65F)

3 Function

3.1 Input voltage range

■The range is from 85VAC to 264VAC.
In cases that conform with safety standard, input voltage range is 100VAC to 240VAC (50/60Hz).
When DC input is required, Please contact us.

■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.
If the restart time of the short interruption power failure is less than 3 seconds, perform a thorough evaluation.

■A power factor improvement circuit (active filter) is not built-in. If you use multiple units for a single system, standards for input harmonic current may not be satisfied. Please contact us for details.

3.2 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.

■Thermistor 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 a power supply cools down before being turned on.

3.3 Overcurrent protection

■An overcurrent protection circuit is built-in and activated over 105% 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.

■Hiccup Operation Mode
When the output voltage drops at overcurrent, the average output current is reduced by hiccup operation of power supply.
Please contact us for details.

3.4 Overvoltage protection

■An 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 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.

3.5 Output ripple and ripple noise

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

■Capacitors Co and C1 should be hybrid electrolytic capacitors, ceramic capacitors, or other capacitors with good high frequency characteristics. The output ripple voltage may be affected by the ESR/ESL of the capacitor or the wiring impedance.

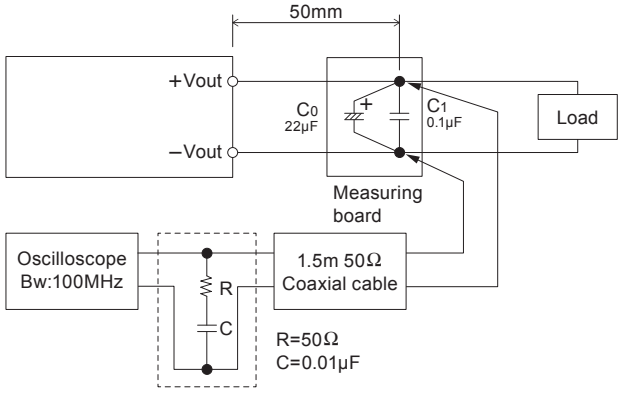
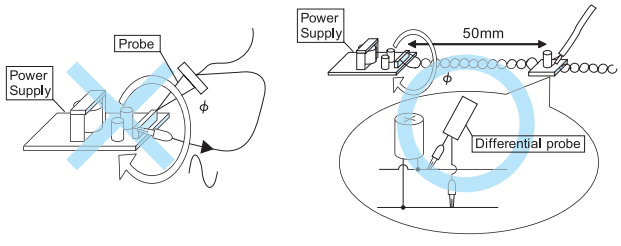


Fig.3.1 Measuring method of Ripple and Ripple Noise

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.3.2. Example of measuring output ripple and ripple noise

3.6 Isolation

■For a receiving inspection, such as Hi-Pot test, gradually increase (decrease) the voltage for the start (shut down). Avoid using Hi-Pot tester with the timer because it may generate voltage a few times higher than the applied voltage, at ON/OFF of a timer.

■When testing isolation between input and output, Short-circuit the input and output respectively.

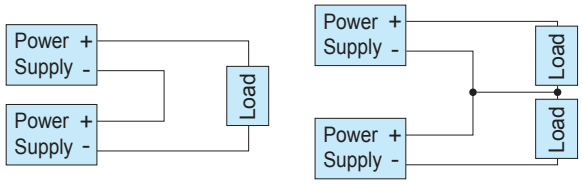
3.7 Reducing standby power

■Burst operation at light loading, the internal switch element is intermittent operated, and the switching loss is decreased.
(Standby power of 230VAC input : 0.1W typ at TEPS10F/20F, 0.2W typ at TEPS45F/65F)
Burst operation can cause sound noise.

4 Series / Parallel and Redundancy Operation

4.1 Series operation

■You can use a power supply in series operation. The output current in series operation should be lower than the rated current of a power supply with the lowest rated current among power supplies that are serially connected. Please make sure that no current exceeding the rated current flows into a power supply.



(a) (b)

Fig.4.1 Examples of connecting in series operation

4.2 Parallel and redundancy operation

■Parallel operation is not possible.

■Redundancy operation is available by wiring as shown below.

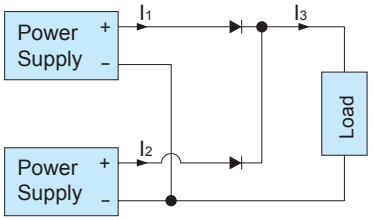


Fig.4.2 Example of redundancy operation

■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

5 Cleaning

■Cleaning agents : IPA (Solvent type)
■Cleaning period : When cleaning the unit, the unit must be washed with a brush, and IPA must be kept out of the unit.
■After cleaning, dry them enough.

6 Temperature Measurement Point

■It is necessary to note thermal fatigue life by power cycle.
Please reduce the temperature fluctuation range as much as possible when the up and down of temperature are frequently generated.
■Please have sufficient ventilation to keep the temperature of point ① in Fig.6.1-6.3 at Table6.1-6.4 or below. Please also make sure that the ambient temperature does not exceed 70℃ (TEPS10F/20F is 85℃).
■The life expectancy in the upper bound temperature is two years or more.
■Please be careful of electric shock or earth leakage in case of temperature measurement, because Point ① is live potential.
■Please contact us for details.

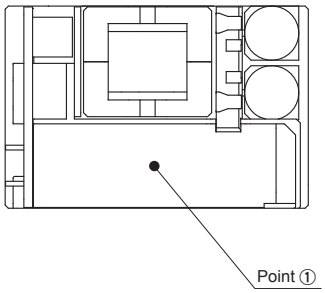


Fig.6.1 Temperature measuring point of TEPS10F/20F (Top View)

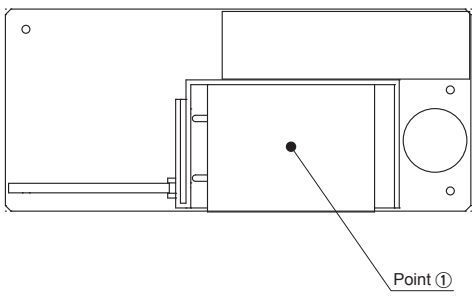


Fig.6.2 Temperature measuring point of TEPS45F (Top View)

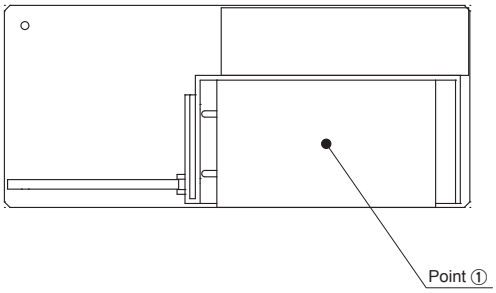


Fig.6.3 Temperature measuring point of TEPS65F (Top View)

Table6.1 Maximum temperature of measurement point (TEPS10F)

Cooling method	Voltage	Mounting method	Load factor	Maximum temperature [℃] ①:Capacitor
Convection	5V	A,B,C,D,E,F	75%<Io≦100%	81
			50%<Io≦ 75%	85
			Io≦ 50%	88
	12V	A,B,C,D,E,F	75%<Io≦100%	83
			50%<Io≦ 75%	89
			Io≦ 50%	90
	15V	A,B,C,D,E,F	75%<Io≦100%	83
			50%<Io≦ 75%	87
			Io≦ 50%	90
	24V	A,B,C,D,E,F	75%<Io≦100%	85
			50%<Io≦ 75%	87
			Io≦ 50%	90
Forced air	5V,12V,15V,24V	A,B,C,D,E,F	70%<Io≦100%	88
			Io≦ 70%	88

Table6.2 Maximum temperature of measurement point (TEPS20F)

Cooling method	Voltage	Mounting method	Load factor	Maximum temperature [℃] ①:Capacitor
Convection	5V	A,B,C,D,E,F	75%<Io≦100%	85
			50%<Io≦ 75%	87
			Io≦ 50%	91
	12V	A,B,C,D,E,F	75%<Io≦100%	87
			50%<Io≦ 75%	89
			Io≦ 50%	91
	15V	A,B,C,D,E,F	75%<Io≦100%	84
			50%<Io≦ 75%	88
			Io≦ 50%	91
	24V	A,B,C,D,E,F	75%<Io≦100%	86
			50%<Io≦ 75%	89
			Io≦ 50%	91
Forced air	5V,12V,15V,24V	A,B,C,D,E,F	70%<Io≦100%	88
			Io≦ 70%	88

Table6.3 Maximum temperature of measurement point (TEPS45F)

Cooling method	Voltage	Mounting method	Load factor	Maximum temperature [℃] ①:Capacitor
Convection	5V	A,C,E,F	60%<Io≦100%	80
			30%<Io≦ 60%	87
			Io≦ 30%	84
		B,D	60%<Io≦100%	76
			30%<Io≦ 60%	85
			Io≦ 30%	83
	12V	A,C,E,F	60%<Io≦100%	81
			30%<Io≦ 60%	89
			Io≦ 30%	86
		B,D	60%<Io≦100%	78
			30%<Io≦ 60%	86
			Io≦ 30%	85
	24V	A,C,E,F	70%<Io≦100%	86
			40%<Io≦ 70%	90
			Io≦ 40%	86
		B,D	70%<Io≦100%	85
			40%<Io≦ 70%	88
			Io≦ 40%	85
Forced air	5V,12V,24V	A,B,C,D,E,F	70%<Io≦100%	80
			Io≦ 70%	80

Table6.4 Maximum temperature of measurement point (TEPS65F)

Cooling method	Voltage	Mounting method	Load factor	Maximum temperature [℃] ①:Capacitor
Convection	5V	A,C,E	60%<Io≦100%	85
			30%<Io≦ 60%	88
			Io≦ 30%	84
		B,D,F	60%<Io≦100%	79
			30%<Io≦ 60%	86
			Io≦ 30%	83
	12V	A,C,E	60%<Io≦100%	85
			30%<Io≦ 60%	91
			Io≦ 30%	85
		B,D,F	60%<Io≦100%	77
			30%<Io≦ 60%	86
			Io≦ 30%	80
	24V	A,C,E	70%<Io≦100%	87
			40%<Io≦ 70%	91
			Io≦ 40%	84
		B,D,F	70%<Io≦100%	80
			40%<Io≦ 70%	85
			Io≦ 40%	78
Forced air	5V,12V,24V	A,B,C,D,E,F	70%<Io≦100%	80
			Io≦ 70%	80

7 Life Expectancy and Warranty

■Life expectancy

Table7.1 Life expectancy (TEPS10F)

Cooling method	Voltage	Mounting method	Average ambient temperature (year)	Life expectancy Load factor Io≦75%	Life expectancy Load factor 75%<Io≦100%
Convection	5V	A,B,C,D,E,F	Ta=50℃ or less	10years or more	6years
			Ta=60℃	5years	3years
	12V	A,B,C,D,E,F	Ta=50℃ or less	10years or more	10years or more
			Ta=60℃	9years	6years
	15V	A,B,C,D,E,F	Ta=50℃ or less	10years or more	10years or more
			Ta=60℃	9years	7years
	24V	A,B,C,D,E,F	Ta=50℃ or less	10years or more	10years or more
			Ta=60℃	10years or more	8years
Forced air	5V,12V,15V,24V	A,B,C,D,E,F	Ta=60℃ or less	5years	5years
			Ta=70℃	5years	3years

Table7.2 Life expectancy (TEPS20F)

Cooling method	Voltage	Mounting method	Average ambient temperature (year)	Life expectancy Load factor Io≦75%	Life expectancy Load factor 75%<Io≦100%
Convection	5V	A,B,C,D,E,F	Ta=40℃ or less	10years or more	8years
			Ta=50℃	7years	4years
	12V	A,B,C,D,E,F	Ta=45℃ or less	10years or more	10years or more
			Ta=55℃	10years or more	6years
	15V	A,B,C,D,E,F	Ta=45℃ or less	10years or more	10years or more
			Ta=55℃	10years or more	5years
	24V	A,B,C,D,E,F	Ta=45℃ or less	10years or more	10years or more
			Ta=55℃	10years or more	6years
Forced air	5V,12V,15V,24V	A,B,C,D,E,F	Ta=60℃ or less	5years	5years
			Ta=70℃	5years	3years

Table7.3 Life expectancy (TEPS45F)

Cooling method	Voltage	Mounting method	Average ambient temperature (year)	Life expectancy Load factor Io≦75%	Life expectancy Load factor 75%<Io≦100%
Convection	5V	A,B,C,D,E,F	Ta=30℃ or less	10years or more	10years or more
			Ta=40℃	10years or more	6years
	12V	A,B,C,D,E,F	Ta=30℃ or less	10years or more	10years or more
			Ta=40℃	10years or more	5years
	24V	A,B,C,D,E,F	Ta=40℃ or less	10years or more	7years
			Ta=50℃	7years	3years
Forced air	5V,12V,24V	A,B,C,D,E,F	Ta=50℃ or less	5years	5years
			Ta=60℃	5years	3years

Table7.4 Life expectancy (TEPS65F)

Cooling method	Voltage	Mounting method	Average ambient temperature (year)	Life expectancy	
				Load factor	
				Io≦75%	75%<Io≦100%
Convection	5V	A,B,C,D,E	Ta=40℃ or less	10years or more	10years or more
			Ta=50℃	10years or more	6years
		F	Ta=35℃ or less	10years or more	10years or more
			Ta=45℃	10years or more	6years
	12V	A,B,C,E	Ta=35℃ or less	10years or more	8years
			Ta=45℃	10years or more	4years
		D,F	Ta=30℃ or less	10years or more	10years or more
			Ta=40℃	10years or more	6years
	24V	A,B,C,E	Ta=40℃ or less	10years or more	7years
			Ta=50℃	9years	3years
		D,F	Ta=35℃ or less	10years or more	10years or more
			Ta=45℃	10years or more	5years
Forced air	5V,12V,24V	A,B,C,D,E,F	Ta=50℃ or less	5years	5years
			Ta=60℃	5years	3years

■Warranty

Table7.5 Warranty (TEPS10F)

(1) Convection

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦75%	75%<Io≦100%
5V	A,B,C,D,E,F	Ta=50℃ or less	5years	5years
		Ta=60℃	4years	2years
12V,15V,24V	A,B,C,D,E,F	Ta=50℃ or less	5years	5years
		Ta=60℃	5years	3years

(2) Forced air (0.5m^3/min)

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦70%	70%<Io≦100%
5V,12V,15V,24V	A,B,C,D,E,F	Ta=60℃ or less	5years	5years
		Ta=70℃	5years	3years

Table7.6 Warranty (TEPS20F)

(1) Convection

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦75%	75%<Io≦100%
5V	A,B,C,D,E,F	Ta=40℃ or less	5years	5years
		Ta=50℃	5years	3years
12V,15V,24V	A,B,C,D,E,F	Ta=45℃ or less	5years	5years
		Ta=55℃	5years	3years

(2) Forced air (0.5m^3/min)

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦70%	70%<Io≦100%
5V,12V,15V,24V	A,B,C,D,E,F	Ta=60℃ or less	5years	5years
		Ta=70℃	5years	3years

Table7.7 Warranty (TEPS45F)

(1) Convection

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦75%	75%<Io≦100%
5V	A,B,C,D,E,F	Ta=30℃ or less	5years	5years
		Ta=40℃	5years	3years
12V	A,B,C,D,E,F	Ta=30℃ or less	5years	5years
		Ta=40℃	5years	3years
24V	A,B,C,D,E,F	Ta=40℃ or less	5years	5years
		Ta=50℃	5years	3years

(2) Forced air (0.5m^3/min)

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦70%	70%<Io≦100%
5V,12V,24V	A,B,C,D,E,F	Ta=50℃ or less	5years	5years
		Ta=60℃	5years	3years

Table7.8 Warranty (TEPS65F)

(1) Convection

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦75%	75%<Io≦100%
5V	A,B,C,D,E	Ta=40℃ or less	5years	5years
		Ta=50℃	5years	3years
	F	Ta=35℃ or less	5years	5years
		Ta=45℃	5years	3years
12V	A,B,C,E	Ta=35℃ or less	5years	5years
		Ta=45℃	5years	3years
	D,F	Ta=30℃ or less	5years	5years
		Ta=40℃	5years	3years
24V	A,B,C,E	Ta=40℃ or less	5years	5years
		Ta=50℃	5years	3years
	D,F	Ta=35℃ or less	5years	5years
		Ta=45℃	5years	3years

(2) Forced air (0.5m^3/min)

Voltage	Mounting method	Average ambient temperature (year)	Warranty term	
			Load factor	
			Io≦70%	70%<Io≦100%
5V,12V,24V	A,B,C,D,E,F	Ta=50℃ or less	5years	5years
		Ta=60℃	5years	3years

8 Option and Others

8.1 Outline of options

● -E2 (TEPS45F/65F)

- Option -E2 models are low leakage current type.
- The capacitor between primary and secondary has been changed from the standard type.
- Differences from standard versions are summarized in Table 8.1.

Table 8.1 Low leakage current type

Leakage Current	0.15mA Max
Conducted Noise	N/A

● -H (TEPS45F12,24/TEPS65F12,24)

- Option -H models can output the peak current.
  Peak load is possible to draw as below.

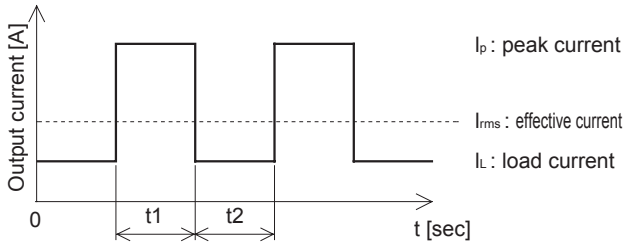


Fig.8.1 Peak current

TEPS45F

- $I_{rms}^2 = \frac{I_P^2 t_1 + I_L^2 t_2}{t_1 + t_2}$
- $t_1 \leqq 10$[sec]
- $I_p \leqq$ Rated peak current[A] Refer to Fig 8.2
- $I_{rms} \leqq$ Rated output current[A]
- Duty $= \frac{t_1}{t_1 + t_2} \times 100[\%] \leqq 45[\%]$

TEPS65F

- $I_{rms}^2 = \frac{I_P^2 t_1 + I_L^2 t_2}{t_1 + t_2}$
- $t_1 \leqq 5$[sec]
- $I_p \leqq$ Rated peak current[A] Refer to Fig 8.2
- $I_{rms} \leqq$ Rated output current[A]
- Duty $= \frac{t_1}{t_1 + t_2} \times 100[\%]$ Refer to Fig 8.3 derating

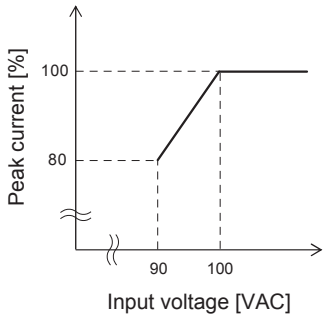


Fig.8.2 Peak current derating curve depending on input voltage

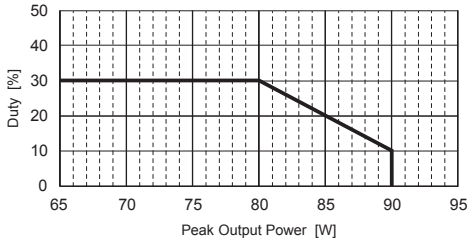


Fig.8.3 Duty of peak output power (TEPS65F)

● -N (TEPS45F/65F)

- -N indicates a type with cover (Refer to external view).
- Please refer to “Derating”.
- Please refer to Fig 8.4 for the position of Point①.
  “Maximum tenperature of measurement points”, “Life expectancy” and “Warranty” is different from standard models. Please refer to Table 8.2 to Table 8.7.
- The life expectancy in the upper bound temperature is two years or more.

■Temperature Measurement Point

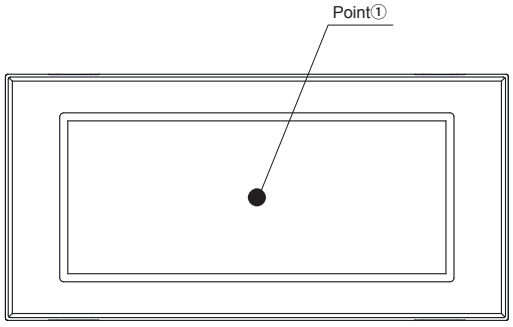


Fig.8.4 Temperature measurement point (-N model)

Table8.2 Maximum temperature of measurement point (TEPS45F-N)

Cooling method	Voltage	Mounting method	Load factor	Maximum temperature [℃] Point①
Convection	5V	A,C,E	60%<Io≦100%	75
			30%<Io≦ 60%	85
			Io≦ 30%	83
		B,D	60%<Io≦100%	73
			30%<Io≦ 60%	84
			Io≦ 30%	83
	12V	A,C,E	60%<Io≦100%	76
			30%<Io≦ 60%	85
			Io≦ 30%	84
		B,D	60%<Io≦100%	74
			30%<Io≦ 60%	85
			Io≦ 30%	84
	24V	A,C,E	60%<Io≦100%	83
			30%<Io≦ 60%	88
			Io≦ 30%	85
		B,D	60%<Io≦100%	81
			30%<Io≦ 60%	86
			Io≦ 30%	84
Forced air	5V,12V,24V	A,B,C,D,E,F	70%<Io≦100%	70
			Io≦ 70%	76

Table8.3 Maximum temperature of measurement point (TEPS65F-N)

Cooling method	Voltage	Mounting method	Load factor	Maximum temperature [℃] Point①
Convection	5V	A,C	60%<Io≦100%	81
			30%<Io≦ 60%	86
			Io≦ 30%	84
		B,D,E	60%<Io≦100%	79
			30%<Io≦ 60%	84
			Io≦ 30%	83
	12V	A,C,E	60%<Io≦100%	81
			30%<Io≦ 60%	86
			Io≦ 30%	86
		B,D	60%<Io≦100%	79
			30%<Io≦ 60%	86
			Io≦ 30%	86
	24V	A,C,E	60%<Io≦100%	83
			30%<Io≦ 60%	87
			Io≦ 30%	83
		B,D	60%<Io≦100%	79
			30%<Io≦ 60%	81
			Io≦ 30%	77
Forced air	5V,12V,24V	A,B,C,D,E,F	70%<Io≦100%	72
			Io≦ 70%	76

■Life Expectancy

Table8.4 Life Expectancy (TEPS45F-N)

Cooling method	Voltage	Mounting method	Average ambient temperature (year)	Life expectancy Load factor Io≦75%	Life expectancy Load factor 75%<Io≦100%
Convection	5V	A,B,C,D,E	Ta=20℃ or less	10years or more	10years or more
			Ta=30℃	10years or more	7years
	12V	A,B,C,D,E	Ta=20℃ or less	10years or more	10years or more
			Ta=30℃	10years or more	8years
	24V	A,B,C,D,E	Ta=30℃ or less	10years or more	10years or more
			Ta=40℃	10years or more	6years
Forced air	5V,12V,24V	A,B,C,D,E,F	Ta=40℃ or less	5years	5years
			Ta=50℃	5years	3years

Table8.5 Life Expectancy (TEPS65F-N)

Cooling method	Voltage	Mounting method	Average ambient temperature (year)	Life expectancy Load factor Io≦75%	Life expectancy Load factor 75%<Io≦100%
Convection	5V	A,B,C,D,E	Ta=30℃ or less	10years or more	10years or more
			Ta=40℃	10years or more	7years
	12V	A,B,C,D,E	Ta=30℃ or less	10years or more	7years
			Ta=40℃	10years or more	3years
	24V	A,B,C,D,E	Ta=30℃ or less	10years or more	10years or more
			Ta=40℃	10years or more	6years
Forced air	5V,12V,24V	A,B,C,D,E,F	Ta=40℃ or less	5years	5years
			Ta=50℃	5years	3years

■Warranty

Table8.6 Warranty term (TEPS45F-N)

(1) Convection

Voltage	Mounting method	Average ambient temperature (year)	Warranty term Load factor Io≦75%	Warranty term Load factor 75%<Io≦100%
5V,12V	A,B,C,D,E	Ta=20℃ or less	5years	5years
		Ta=30℃	5years	2years
24V	A,B,C,D,E	Ta=30℃ or less	5years	5years
		Ta=40℃	5years	2years

(2) Forced air (0.5m^3/min)

Voltage	Mounting method	Average ambient temperature (year)	Warranty term Load factor Io≦70%	Warranty term Load factor 70%<Io≦100%
5V,12V,24V	A,B,C,D,E,F	Ta=40℃ or less	5years	5years
		Ta=50℃	5years	3years

Table8.7 Warranty term (TEPS65F-N)

(1) Convection

Voltage	Mounting method	Average ambient temperature (year)	Warranty term Load factor Io≦75%	Warranty term Load factor 75%<Io≦100%
5V,12V,24V	A,B,C,D,E	Ta=30℃ or less	5years	4years
		Ta=40℃	5years	2years

(2) Forced air (0.5m^3/min)

Voltage	Mounting method	Average ambient temperature (year)	Warranty term Load factor Io≦70%	Warranty term Load factor 70%<Io≦100%
5V,12V,24V	A,B,C,D,E,F	Ta=40℃ or less	5years	5years
		Ta=50℃	5years	3years