HWS SERIES

Single Output 300W-1800W

Contents

HWS

UL60950-1/ CSA C22.2 No.60950-1 | UL508/CSA C22.2 No.14-M95 (HWS300,600 24Vout only) | EN60950-1/ EN50178

Low Voltage Directive | DENAN Built to meet Electrical Appliance and Material Safety Law (Input Voltage 100VAC) | 5 YEARS warranty

■ Features

- Environmentally-friendly: High-efficiency technology reduces power loss by heat generation. Fan stopping in power-off by external control reduces acoustic noise and saves energy.
- Easy to use: All models in the same hight of 82mm. Mountable in 2U-height racks without dead space.
- Safety and reliability: “Safety terminal” covering current flowing part secures safety for users. “No screw-dropping” design prevents from losing screws during maintenance operation.

■ Model naming method

HWS 300 − 5 / □□

Series name | Output power

Blank: With cover, forced air cooling with built-in fan
PV: Output voltage adjustable by external voltage 12Vout+ models for HWS300, 600 only. (Supported by standard models for HWS1000 and above.)

Nominal output voltage
ex. 3: 3.3V, 5: 5V, 48: 48V

■ Applications

COMP COM MEASURE F A SEMI

■ Conformity to RoHS Directive

■ Product Line up

Output Voltage	300W		600W		1000W		1500W		1800W	
	Output Current (Peak)	Model	Output Current (Peak)	Model	Output Current (Peak)	Model	Output Current (※) (Peak)	Model	Output Current (Peak)	Model
3.3V	60A	HWS300-3	120A	HWS600-3	200A	HWS1000-3	300A/300A	HWS1500-3	300A	HWS1800T-3
5V	60A	HWS300-5	120A	HWS600-5	200A	HWS1000-5	300A/300A	HWS1500-5	300A	HWS1800T-5
6V	—	—	—	—	167A	HWS1000-6	250A/250A (300A)	HWS1500-6	250A (300A)	HWS1800T-6
7.5V	—	—	—	—	134A (160A)	HWS1000-7	200A/200A (240A)	HWS1500-7	200A (240A)	HWS1800T-7
12V	27A	HWS300-12	53A	HWS600-12	88A (100A)	HWS1000-12	125A/125A	HWS1500-12	125A (150A)	HWS1800T-12
15V	22A	HWS300-15	43A	HWS600-15	70A (80A)	HWS1000-15	100A/100A	HWS1500-15	100A (120A)	HWS1800T-15
24V	14A (16.5A)	HWS300-24	27A (31A)	HWS600-24	46A (58.5A)	HWS1000-24	65A/70A (105A)	HWS1500-24	75A (105A)	HWS1800T-24
36V	—	—	—	—	30.7A (39A)	HWS1000-36	42A/46.5A (70A)	HWS1500-36	50A (70A)	HWS1800T-36
48V	7A	HWS300-48	13A	HWS600-48	23A (29.2A)	HWS1000-48	32A/32A	HWS1500-48	37.5A (52.5A)	HWS1800T-48
60V	—	—	—	—	18.4A (23.4A)	HWS1000-60	25.6A/28A (42A)	HWS1500-60	30A (42A)	HWS1800T-60

(※) (100Vin / 200Vin)

HWS300 Specifications(Read instruction manual carefully, before using the power supply unit.)

ITEMS/UNITS			MODEL	HWS300-3	HWS300-5	HWS300-12	HWS300-15	HWS300-24	HWS300-48
Input	Voltage Range	(*2)	V	AC85 - 265 or DC120 - 330					
	Frequency	(*2)	Hz	47 - 63					
	Power Factor (100/200VAC)(typ)	(*1)		0.99 / 0.95					
	Efficiency (100/200VAC)(typ)	(*1)	%	74 / 77	79 / 82	80 / 83		82 / 85	
	Current (100/200VAC)(typ)	(*1)	A	2.7 / 1.4	3.8 / 1.9	4.1 / 2.1			
	Inrush Current (100/200VAC)(typ)	(*3)	A	20 / 40					
	Leakage Current	(*10)	mA	Less than 0.75. (0.2 (typ) at 100VAC / 0.44 (typ) at 230VAC)					
Output	Nominal Voltage		VDC	3.3	5	12	15	24	48
	Maximum Current	(*13)	A	60		27	22	14 (16.5)	7
	Maximum Power		W	198	300	324	330	336	
	Maximum Line Regulation	(*5)	mV	20		48	60	96	192
	Maximum Load Regulation	(*6)	mV	30		72	90	144	288
	Temperature Coefficient			Less than 0.02% / ℃					
	Maximum Ripple & Noise (0≦Ta≦70℃)	(*4)	mVp-p	120		150			350
	Maximum Ripple & Noise (−10≦Ta<0℃)	(*4)	mVp-p	180		200			400
	Hold-up Time (typ)	(*9)	ms	20					
	Voltage Adjustable Range		VDC	2.64 - 3.96	4.0 - 6.0	9.6 - 14.4	12.0 - 18.0	19.2 - 28.8	38.4 - 52.8
Function	Over Current Protection	(*7)	A	>63		> 28.4	>23.1	>16.7	>7.4
	Over Voltage Protection	(*8)	VDC	4.13 - 4.95	6.25 - 7.25	15.0 - 17.4	18.8 - 21.8	30.0 - 34.8	55.2 - 64.8
	Remote Sensing			Possible					
	Remote ON/OFF Control			Possible					
	Parallel Operation			Possible					
	Series Operation			Possible					
	Monitoring Signal			PF (Open collector output)					
	Line DIP			Designed to meet SEMI-F47 (200VAC Line only)					
Environment	Operating Temperature	(*11)	°C	-10 to +70 (-10 to +50: 100%, +70: 50%)					
	Storage Temperature		°C	-30 to +85					
	Operating Humidity		%RH	10 - 90 (No dewdrop)					
	Storage Humidity		%RH	10 - 95 (No dewdrop)					
	Vibration			At no operating, 10 - 55Hz (sweep for 1min) 19.6m/s² constant, X, Y, Z 1hour each.					
	Shock (In package)			Less than 196.1m/s²					
	Cooling			Forced air by blower fan					
Isolation	Withstand Voltage			Input - FG : 2.5kVAC (20mA), Input - Output : 3kVAC (20mA) Output - FG: 500VAC (100mA), Output-CNT: 100VAC(100mA) for 1min					
	Isolation Resistance			More than 100MΩ Output - FG : 500VDC More than 10MΩ Output -CNT : 100VDC at 25℃ and 70%RH					
Standards	Safety Standards	(*12)		Approved by UL60950-1, UL508 (24V model only), CSA C22.2 No.60950-1, CSA C22.2 No.14-M95 (24V model only), EN60950-1, EN50178 Designed to meet DENAN					
	PFHC			Designed to meet IEC61000-3-2					
	EMI			Designed to meet EN55011/EN55022-B, FCC-B, VCCI-B					
	Immunity			Designed to meet IEC61000-4-2(Level 2,3), -3(Level 3), -4(Level3), -5(Level 3,4), -6(Level 3), -8(Level 4), -11					
Mechani-cal	Weight (typ)		g	1000					
	Size (W x H x D)		mm	61 x 82 x 165 (Refer to outline drawing)					

(*1) At 100/200VAC, Ta=25℃ and maximum output power.

(*2) For cases where conformance to various safety specs (UL, CSA, EN) are required, to be described as 100-240VAC (50/60Hz).

(*3) Not applicable for the inrush current to noise filter for less than 0.2ms.

(*4) Measure with JEITA RC-9131A probe, bandwidth of scope :100MHz.

(*5) 85 - 265VAC, constant load.

(*6) No load-full load, constant input voltage.

(*7) 3.3, 5V model: Constant current limit and hiccup with automatic recovery.
12 - 48V model: Constant current limit with automatic recovery.
Avoid to operate at over load or short circuit condition for more than 30 seconds.

(*8) OVP circuit will shut the output down, manual reset (CNT reset or Re power on).

(*9) At 100/200VAC, nominal output voltage and maximum output current.

(*10) Measured by the each measuring method of UL, CSA, EN and DENAN (at 60Hz), Ta=25 .

(*11) Ratings - Derating at standard mounting. Refer to output derating curve.
- Load (%) is percent of maximum output power or maximum output current, whichever is greater.

(*12) As for DENAN, designed to meet at 100VAC.

(*13) ( ): Peak output current at 200VAC. Operaing time at peak output is less than 10 sec, duty is less than 35%.

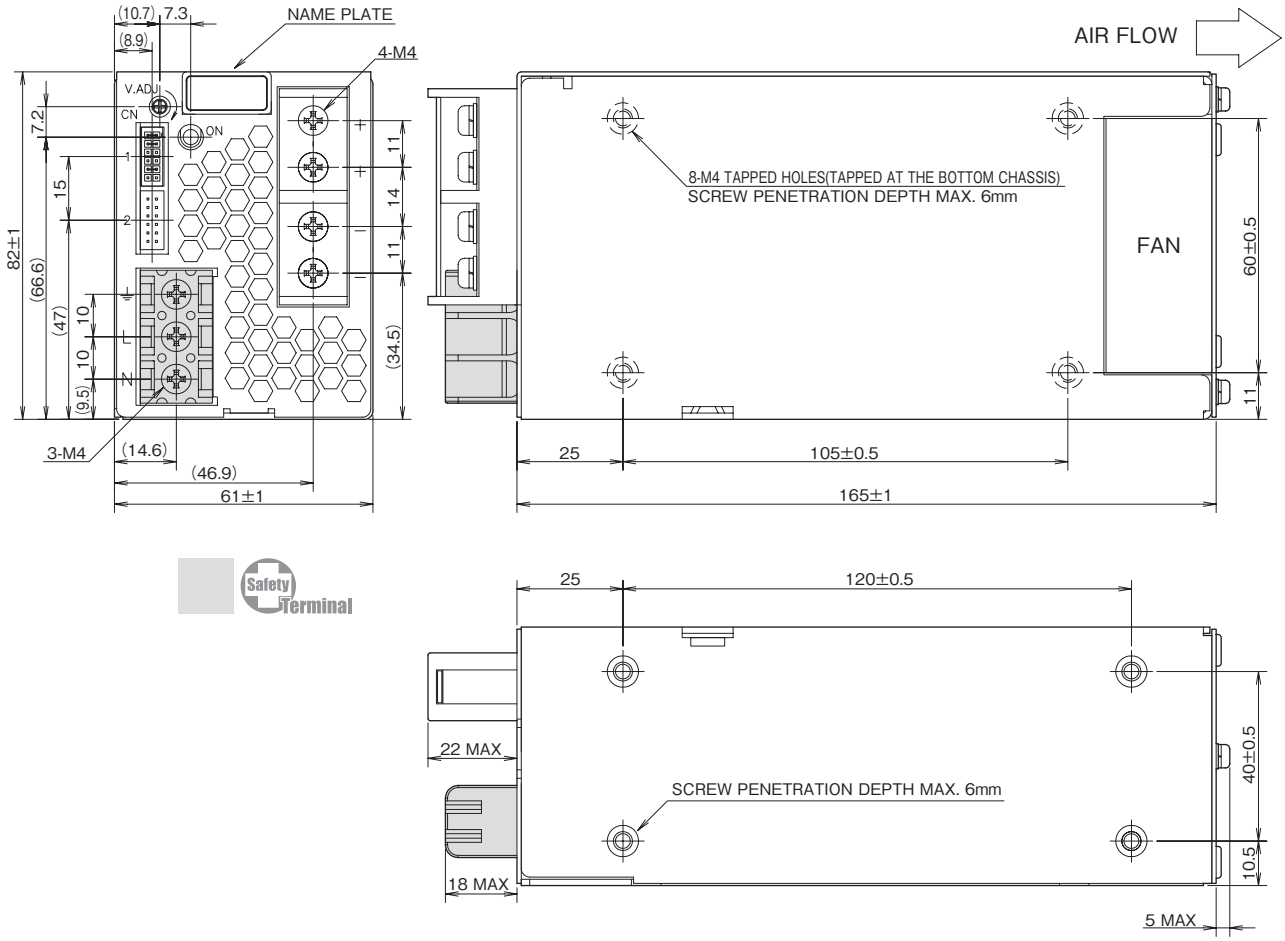
●Recommended EMC Filter

RSEN-2006

Please refer to "TDK-Lambda EMC Filters" catalog.

Outline Drawing

【HWS300】



[unit: mm]

== SIGNAL CONNECTOR USED ==

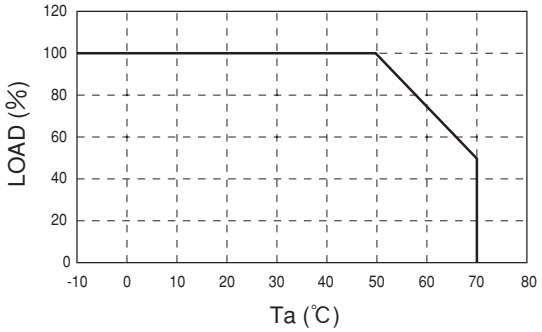
PART DESCRIPTION	PART NAME	MANUFACT
PIN HEADER	S12B-PHDSS	JST

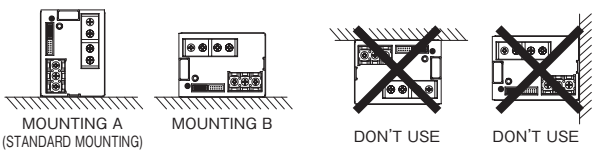
== MATCHING HOUSINGS , PINS & TOOL ==

PART DESCRIPTION	PART NAME	MANUFACT
SOCKET HOUSING	PHDR-12VS	JST
TERMINAL PINS	SPHD-002T-P0.5 (AWG28 - 24) SPHD-001T-P0.5 (AWG26 - 22)	JST
HAND CRIMRING TOOL	YRS-620 (SPHD-002T-P0.5) YC-610R (SPHD-001T-P0.5)	JST

== ACCESSORIES ==
*COVER FOR BARRIER TERMINAL STRIP ------1
(ATTACHED ON TERMINAL AT SHIPMENT)
*SHORT PIECE ----------1
SHORTING +Vm — +S, -Vm — -S. CNT—TOG
(ATTACHED ON CN1 AT SHIPMENT)

Output Derating





HWS600 Specifications(Read instruction manual carefully, before using the power supply unit.)

ITEMS/UNITS		MODEL	HWS600-3	HWS600-5	HWS600-12	HWS600-15	HWS600-24	HWS600-48
Input	Voltage Range (*2)	V	AC85 - 265 or DC120 - 330					
	Frequency (*2)	Hz	47 - 63					
	Power Factor (100/200VAC)(typ) (*1)		0.99 / 0.95					
	Efficiency (100/200VAC)(typ) (*1)	%	75 / 78	80 / 83		81 / 84	82 / 85	83 / 86
	Current (100/200VAC)(typ) (*1)	A	5.4 / 2.6	7.5 / 3.6	8.1 / 3.9			
	Inrush Current (100/200VAC)(typ) (*3)	A	20 / 40					
	Leakage Current (*10)	mA	Less than 0.75. (0.2 (typ) at 100VAC / 0.44 (typ) at 230VAC)					
Output	Nominal Voltage	VDC	3.3	5	12	15	24	48
	Maximum Current (*13)	A	120		53	43	27(31)	13
	Maximum Power	W	396	600	636	645	648	624
	Maximum Line Regulation (*5)	mV	20		48	60	96	192
	Maximum Load Regulation (*6)	mV	30		72	90	144	288
	Temperature Coefficient		Less than 0.02% / ℃					
	Maximum Ripple & Noise (0≦Ta≦70℃) (*4)	mVp-p	120		150			350
	Maximum Ripple & Noise (-10≦Ta<0℃) (*4)	mVp-p	180		200			400
	Hold-up Time (typ) (*9)	ms	20ms					
	Voltage Adjustable Range	VDC	2.64 - 3.96	4.0 - 6.0	9.6 - 14.4	12.0 - 18.0	19.2 - 28.8	38.4 - 52.8
Function	Over Current Protection (*7)	A	>126		>55.7	>45.2	>31.4	>13.7
	Over Voltage Protection (*8)	VDC	4.13 - 4.95	6.25 - 7.25	15.0 - 17.4	18.8 - 21.8	30.0 - 34.8	55.2 - 64.8
	Remote Sensing		Possible					
	Remote ON/OFF Control		Possible					
	Parallel Operation		Possible					
	Series Operation		Possible					
	Monitoring Signal		PF (Open collector output)					
	Line DIP		Designed to meet SEMI-F47 (200VAC Line only)					
Environment	Operating Temperature (*11)	°C	-10 to +70 (-10 to +50: 100%, +70: 50%)					
	Storage Temperature	°C	-30 to +85					
	Operating Humidity	%RH	10 - 90 (No dewdrop)					
	Storage Humidity	%RH	10 - 95 (No dewdrop)					
	Vibration		At no operating, 10 - 55Hz (sweep for 1min) 19.6m/s² constant, X, Y, Z 1hour each.					
	Shock (In package)		Less than 196.1m/s²					
	Cooling		Forced air by blower fan					
Isolation	Withstand Voltage		Input - FG : 2.5kVAC (20mA), Input - Output : 3kVAC (20mA) Output - FG : 500VAC (100mA), Output - CNT : 100VAC (100mA) for 1min					
	Isolation Resistance		More than 100MΩ Output - FG : 500VDC More than 10MΩ Output - CNT: 100VDC at 25℃ and 70%RH					
Standards	Safety Standards (*12)		Approved by UL60950-1, UL508 (24V model only), CSA C22.2 No.60950-1, CSA C22.2 No.14-M95 (24V model only), EN60950-1, EN50178,Designed to meet DENAN					
	PFHC		Designed to meet IEC61000-3-2					
	EMI		Designed to meet EN55011/EN55022-B, FCC-B, VCCI-B					
	Immunity		Designed to meet IEC61000-4-2(Level 2,3), -3(Level 3), -4(Level 3), -5(Level 3,4), -6(Level 3), -8(Level 4), -11					
Mechanical	Weight (typ)	g	1600					
	Size (W x H x D)	mm	100 x 82 x 165 (Refer to outline drawing)					

(*1) At 100/200VAC, Ta=25°C and maximum output power.

(*2) For cases where conformance to various safety specs (UL, CSA, EN) are required, to be described as 100 - 240VAC(50/60Hz).

(*3) Not applicable for the inrush current to Noise Filter for less than 0.2ms.
Inrush Current is 30A(Typ) when PFHC start-up.

(*4) Measure with JEITA RC-9131A probe, Bandwidth of scope :100MHz.

(*5) 85 - 265VAC, constant load.

(*6) No load - Full load, constant input voltage.

(*7) 3V and 5V model: Constant current limit and hiccup with automatic recovery.
12 - 48V model: Constant current limit with automatic recovery.
Avoid to operate at over load or short circuit condition for more than 30seconds.

(*8) OVP circuit will shut the output down, manual reset (CNT reset or Re-power on).

(*9) At 100/200VAC, nominal output voltage and maximum output current.

(*10) Measured by the each measuring method of UL, CSA, EN and DENAN(at 60Hz), Ta=25°C.

(*11) Ratings - Derating at standard mounting. Refer to output derating curve.
- Load (%) is percent of maximum output power or maximum output current, whichever is greater.

(*12) As for DENAN, designed to meet at 100VAC.

(*13) ( ): Peak output current at 200VAC. Operaing time at peak output is less than 10sec, duty is less than 35%.

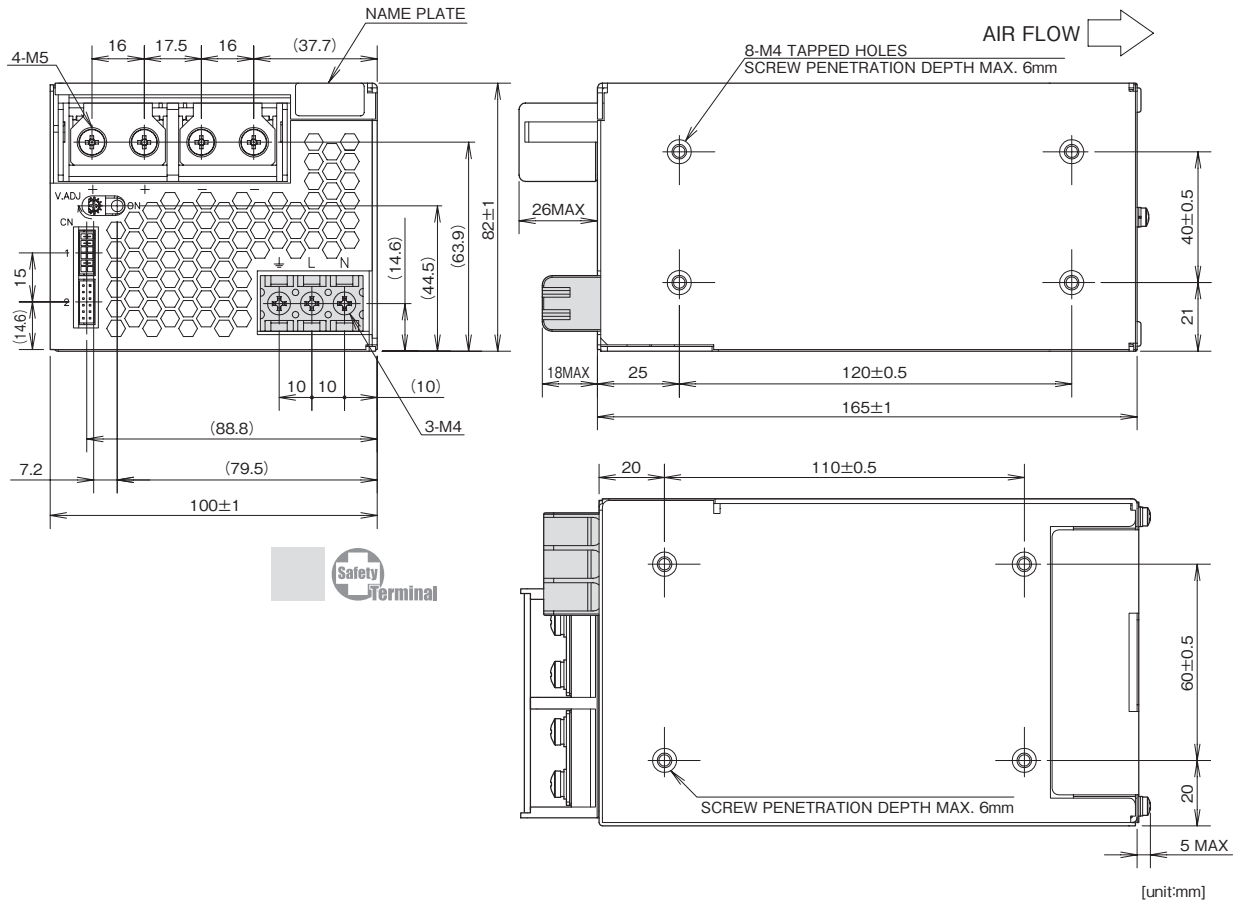
●Recommended EMC Filter

RSEN-2016

Please refer to "TDK-Lambda EMC Filters" catalog.

Outline Drawing

【HWS600】



== SIGNAL CONNECTOR USED ==

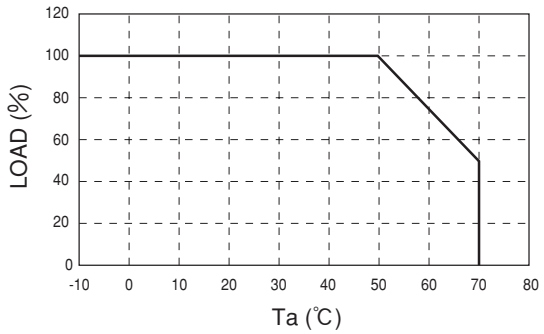
PART DESCRIPTION	PART NAME	MANUFACT
PIN HEADER	S12B-PHDSS	JST

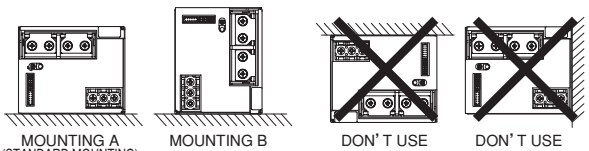
== MATCHING HOUSINGS, PINS & TOOL ==

PART DESCRIPTION	PART NAME	MANUFACT
SOCKET HOUSING	PHDR-12VS	JST
TERMINAL PINS	SPHD-002T-P0.5 (AWG28 - 24) SPHD-001T-P0.5 (AWG26 - 22)	JST
HAND CRIMPING TOOL	YRS-620 (SPHD-002T-P0.5) YC-610R (SPHD-001T-P0.5)	JST

== ACCESSORIES ==
*COVER FOR BARRIER TERMINAL STRIP -----1
(ATTACHED ON TERMINAL AT SHIPMENT)
*SHORT PIECE ----------1
SHORTING +Vm—+S, -Vm—-S, CNT—TOG
(ATTACHED ON CN1 AT SHIPMENT)

Output Derating





HWS1000 Specifications (Read instruction manual carefully, before using the power supply unit.)

ITEMS/UNITS			MODEL	HWS1000 -3	HWS1000 -5	HWS1000 -6	HWS1000 -7	HWS1000 -12	HWS1000 -15	HWS1000 -24	HWS1000 -36	HWS1000 -48	HWS1000 -60
Input	Voltage Range (*2)		V	AC85 - 265 or DC120 - 330									
	Frequency (*2)		Hz	47 - 63									
	Power Factor (100/200VAC)(typ) (*1)			0.98 / 0.95									
	Efficiency (100/200VAC)(typ) (*1)		%	71 / 73	76 / 78	79 / 81	80 / 82	82 / 85	83 / 85	85 / 87	85 / 88	86 / 88	85 / 88
	Current (100/200VAC)(typ) (*1)		A	9.6 / 5.0	13.5 / 7.0								
	Inrush Current (100/200VAC)(typ) (*3)		A	20 / 40									
	Leakage Current (100/240VAC) (*10)		mA	1.2 max									
Output	Nominal Voltage		VDC	3.3	5	6	7.5	12	15	24	36	48	60
	Maximum Current		A	200		167	134	88	70	46	30.7	23	18.4
	Maximum Peak Current (*13)		A	—			160	100	80	58.5	39	29.2	23.4
	Maximum Power		W	660	1000	1002	1005	1056	1050	1104			
	Maximum Peak Power (*13)		W	—			1200			1404			
	Maximum Line Regulation (*5)		mV	20		36		48	60	96	144	192	240
	Maximum Load Regulation (*6)		mV	40		60		100	120	150		300	360
	Temperature Coefficient			Less than 0.02%/℃									
	Maximum Ripple & Noise (*4)	0 to +71℃	mVp-p	120		150					200		400
		-10 to 0℃	mVp-p	160		180					240	500	600
	Hold-up Time (typ) (*9)		ms	20									
	Voltage Adjustable Range		VDC	2.64 - 3.96	4.0 - 6.0	4.8 - 7.2	6.0 - 9.0	9.6 - 14.4	12.0 - 18.0	19.2 - 28.8	28.8 - 43.2	38.4 - 52.8	48.0 - 66.0
Function	Over Current Protection (*7)		A	>210.0		>175.3	>140.7	>92.4	>73.5	>48.3	>32.2	>24.1	>19.3
	Over Voltage Protection (*8)		VDC	4.12 - 4.62	6.25 - 7.0	7.5 - 8.4	9.37 - 10.5	15.0 - 17.4	18.7 - 21.8	30.0 - 34.8	45.0 - 49.7	55.2 - 60.0	69.0 - 75.0
	Remote Sensing			Possible									
	Remote ON/OFF Control			Possible									
	Parallel Operation			Possible									
	Series Operation			Possible									
	Monitoring Signal			PF (Open collector output)									
	Line DIP			Built to meet SEMI-F47 (200VAC line only)									
Environment	Operating Temperature (*11)		℃	-10 to +71 , start up -20 to +71									
		-10 to +40℃	%	100									
		+50℃	%	83.9		100							
		+71℃	%	50									
	Storage Temperature		℃	-30 to +85									
	Operating Humidity		%RH	10 - 90 (No Condensing)									
	Storage Humidity		%RH	10 - 95 (No Condensing)									
	Vibration			At no operating, 10 - 55Hz (sweep for 1min.) 19.6m/s² constant, X, Y, Z 1hour each.									
	Shock (In package)			Less than 196.1m/s²									
	Cooling			Forced air by blower fan									
Isolation	Withstand Voltage			Input - FG : 2kVAC (20mA), Input - Output : 3kVAC (20mA) Output-FG : 500VAC (300mA) (60V model 651VAC (390mA)), Output-CNT:100VAC (100mA) for 1min.									
	Isolation Resistance			More than 100MΩ Output - FG : 500VDC More than 10MΩ Output - CNT 100VDC at 25℃ and 70%RH									
Standards	Safety Standards (*12)			Approved by UL60950-1, CSA C22.2 No60950-1, EN60950-1,EN50178. Built to meet DENAN.									
	PFHC			Built to meet IEC61000-3-2									
	EMI			Built to meet EN55011/EN55022-B, FCC-ClassB, VCCI-ClassB, CISPR-ClassB.									
	Immunity			Built to meet IEC61000-4-2(Level 2,3), -3(Level 3), -4(Level 3), -5(Level 3,4), -6(Level 3), -8(Level 4), -11									
Mechanical	Weight (max)		g	3200									
	Size (W x H x D)		mm	126.5 x 82 x 240 (Refer to outline drawing)									

(*1) At Ta=25℃ and maximum output power.

(*2) For cases where conformance to various safety specs (UL, CSA, EN) are required, input voltage range will be 100 - 240VAC (50/60Hz).

(*3) First in-rush current. Not applicable to the first 0.2ms in-rush current flowing into the power supply noise filter.

(*4) Measure with JEITA RC-9131A probe, bandwidth of scope :100MHz.
At 100uF electric capacitor and 0.47uF film capacitor on the test fixture board.)

(*5) 85 - 265VAC, constant load.

(*6) No load-full load, constant input voltage.

(*7) Constant current limit with automatic recovery. Over current condition for more than 5 seconds will cause the output to shutdown.
Output current exceeding maximum rated output current for more then 10 seconds continuously will result to output shutdown.
For peak current capable model, Over Current Protection triggers at 105% of Maximum Peak Output Current or more with 200VAC input line.

(*8) OVP circuit will shut down output, manual reset (power cycle) or ON/OFF CNT signal reset.

(*9) At 100/200VAC, nominal output voltage and maximum output current.

(*10) Measured by the each measuring method of UL, CSA, EN and DENAN (at 60Hz), Ta=25 .

(*11) Ratings - Derating at standard mounting.
- Load (%) is percent of maximum output power or maximum output current, whichever is greater.
- As for other mountings, refer to derating curve.

(*12) As for DENAN, built to meet at 100VAC.

(*13) Peak output current is less than 10 seconds, and duty 35% max.(200VAC Line only)

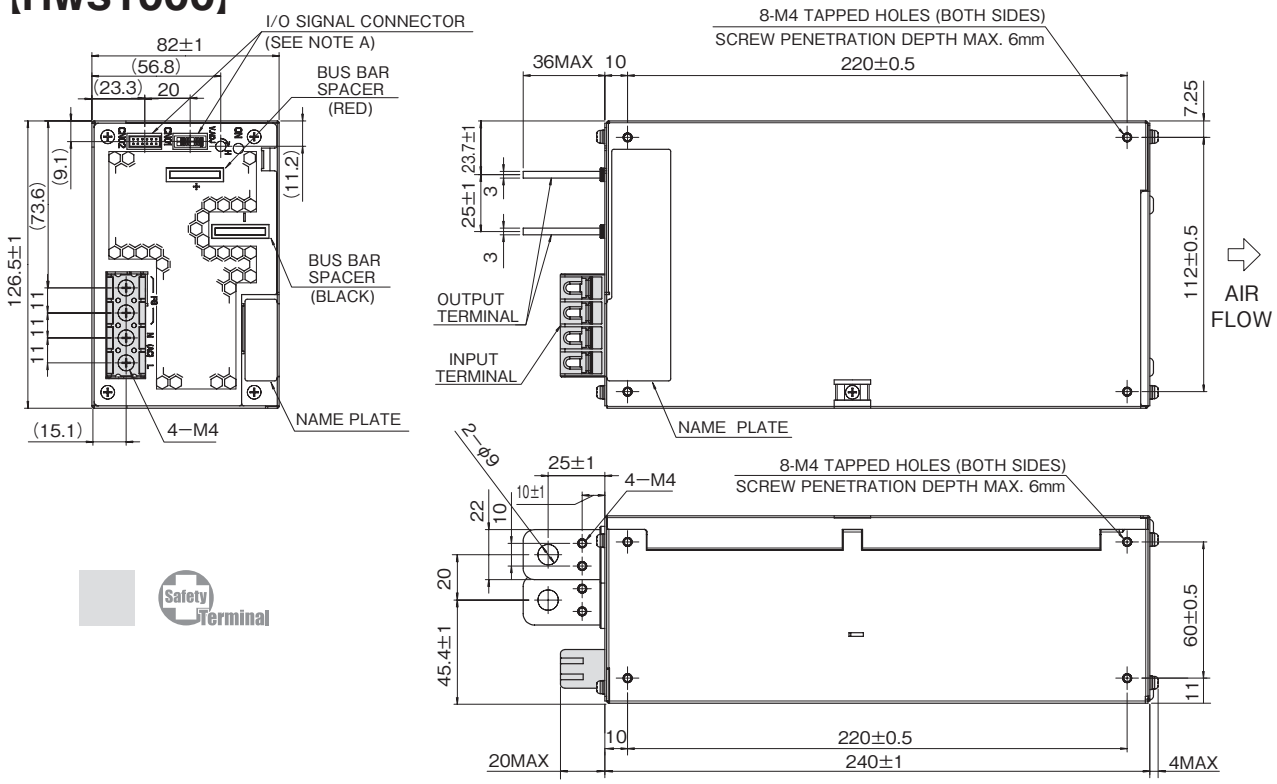
●Recommended EMC Filter

RSEN-2020

Please refer to "TDK-Lambda EMC Filters" catalog.

Outline Drawing

[HWS1000]



[unit: mm]
[Chassis material:SPCC-SD]

NOTES

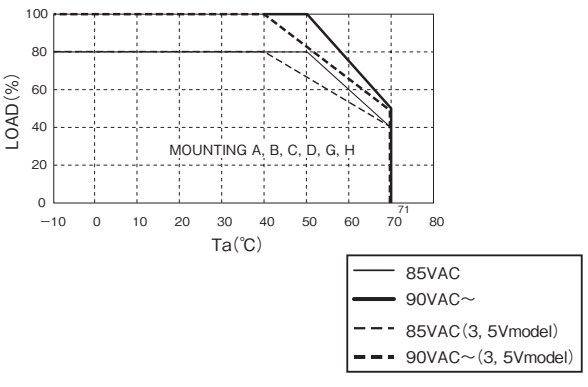
A : I/O SIGNAL CONNECTOR

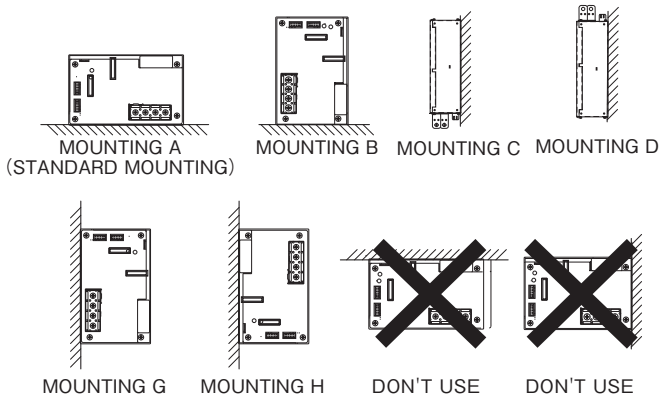
CONNECTOR	:	S12B-PHDSS (LF) (SN)	(JST)
MATCHING HOUSING	:	PHDR-12VS	(JST)
MATCHING CONTACT	:	SPHD-002T-P0.5 (AWG28 - 24)	(JST) OR
		SPHD-001T-P0.5 (AWG26 - 22)	(JST) OR
		BPHD-001T-P0.5 (AWG26 - 22)	(JST)
HAND CRIMPING TOOL	:	YRS-620 (SPHD-002T-P0.5)	(JST)
		YC-610R (SPHD-001T-P0.5)	(JST)
		YC-610R (BPHD-001T-P0.5)	(JST)

ACCESSORIES

* ATTACHED CONNECTOR
  SHORTING +S ～ +V, -S ～ -V, PV ～ REF & CNT ～ TOG ATTACHED ON CN02 AT SHIPMENT
* A separate connector not included is required in order to utilize the power supply function.

Output Derating





*It cannot be used even the product is flipped vertically.

HWS1500 Specifications (Read instruction manual carefully, before using the power supply unit.)

ITEMS/UNITS			MODEL	HWS1500 -3	HWS1500 -5	HWS1500 -6	HWS1500 -7	HWS1500 -12	HWS1500 -15	HWS1500 -24	HWS1500 -36	HWS1500 -48	HWS1500 -60
Input	Voltage Range (*2)		V	AC85 - 265 or DC120 - 330									
	Frequency (*2)		Hz	47 - 63									
	Power Factor (100/230VAC)(typ) (*1)			0.98 / 0.94									
	Efficiency (100/200VAC)(typ) (*1)		%	72 / 75	77 / 81	79 / 82	81 / 83	82 / 85	83 / 87	84 / 88		86 / 90	
	Current (100/200VAC)(typ) (*1)		A	15.0 / 8.0	19.5 / 10.0		19.0 / 10.0						
	Inrush Current (100/200VAC)(typ) (*3)		A	20 / 40									
	Leakage Current (100/240VAC) (*10)		mA	1.5 max									
Output	Nominal Voltage		VDC	3.3	5	6	7.5	12	15	24	36	48	60
	Maximum Current (100/200VAC)		A	300 / 300		250 / 250	200 / 200	125 / 125	100 / 100	65 / 70	42 / 46.5	32 / 32	25.6 / 28
	Maximum Peak Current (*13)		A	–		300	240	–		105	70	–	42
	Maximum Power (100/200VAC)		W	990 / 990	1500 / 1500					1560 / 1680	1512 / 1674	1536 / 1536	1536 / 1680
	Maximum Peak Power (*13)		W	–		1800		–		2520		–	2520
	Maximum Line Regulation (*5)		mV	36			40	48	60	96	144	192	240
	Maximum Load Regulation (*6)		mV	60				72	90	144	150	288	360
	Temperature Coefficient			Less than 0.02%/℃									
	Maximum Ripple & Noise (*4)	+25 to +70℃	mVp-p	150						200			400
		0℃	mVp-p	200				150		200			400
		-10℃	mVp-p	220				200			240	400	600
	Hold-up Time (typ) (*9)		ms	20			16	20					
	Voltage Adjustable Range		VDC	2.64 - 3.96	4.0 - 6.0	4.8 - 7.2	6.0 - 9.0	9.6 - 14.4	12.0 - 18.0	19.2 - 28.8	28.8 - 43.2	38.4 - 52.8	48.0 - 66.0
Function	Over Current Protection (*7)		A	>315.0		>262.5	>210.0	>131.2	>105.0	>68.2	>44.1	>33.6	>26.8
	Over Voltage Protection (*8)		VDC	4.12 - 4.62	6.25 - 7.0	7.5 - 8.4	9.37 - 10.5	15.0 - 17.4	18.7 - 21.8	30.0 - 34.8	45.0 - 49.7	55.2 - 64.8	69.0 - 75.0
	Remote Sensing			Possible									
	Remote ON/OFF Control			Possible									
	Parallel Operation			Possible									
	Series Operation			Possible									
	Monitoring Signal			PF (Open collector output)									
	Line DIP			Built to meet SEMI-F47 (200VAC Line only)									
Environment	Operating Temperature (*11)		℃	-10 to +70, start up -20 to +70									
	at Input Voltage 100VAC/200VAC	-10 to +40°C	W	990	1500					1560 / 1680	1512 / 1674	1536	1536 / 1680
		+50°C	W	825	1250	1500				1560 / 1680	1512 / 1674	1536	1536 / 1680
		+60°C	W	660	1000	1125				1170 / 1260	1134 / 1255	1152	1152 / 1260
		+70°C	W	495	750					780 / 840	756 / 837	768	768 / 840
	Storage Temperature		℃	-30 to +85									
	Operating Humidity		%RH	10 - 90 (No Condensing)									
	Storage Humidity		%RH	10 - 95 (No Condensing)									
	Vibration			At no operating, 10 - 55Hz (sweep for 1min.) 19.6m/s² constant, X, Y, Z 1hour each.									
	Shock (In package)			Less than 196.1m/s²									
	Cooling			Forced air by blower fan									
Isolation	Withstand Voltage			Input - FG : 2kVAC (20mA), Input - Output : 3kVAC (20mA), Output - CNT : 100VAC (100mA) Output - FG : 500VAC (300mA), (60V model 651VAC (390mA)) for 1min.									
	Isolation Resistance			More than 100MΩ Output - FG : 500VDC More than 10MΩ Output - CNT 100VDC at 25℃ and 70%RH									
Standards	Safety Standards (*12)			Approved by UL60950-1, CSA C22.2 No.60950-1, EN60950-1, EN50178. Built to meet DENAN.									
	PFHC			Built to meet IEC61000-3-2									
	EMI			Built to meet EN55011/EN55022-A, FCC-ClassA, VCCI-ClassA.									
	Immunity			Built to meet IEC61000-4-2(Level 2,3), -3(Level 3), -4(Level 3), -5(Level 3,4), -6(Level 3), -8(Level 4), -11									
Mechanical	Weight (typ)		g	4000				3800					
	Size (W x H x D)		mm	126.5 x 82 x 280 (Refer to outline drawing)									

(*1) At Ta=25℃ and maximum output power.

(*2) For cases where conformance to various safety specs (UL, CSA, EN) are required, input voltage range will be 100 - 240VAC (50/60Hz).

(*3) First in-rush current. Not applicable to the first 0.2ms in-rush current flowing into the power supply noise filter.

(*4) Measure with JEITA RC-9131A probe, bandwidth of scope: 100MHz.
(at 100uF electric capacitor and 0.47uF film capacitor on the test fixture board.)
Ripple noise spec for ambient temperature between -10 to 25 is a linearity value with respect to the -10 degrees C and 25 degrees C specs.

(*5) 85 - 265VAC, constant load.

(*6) No load-Full load, constant input voltage.

(*7) Constant current limit with automatic recovery. Over current condition for more than 5 seconds will cause the output to shutdown. Output current exceeding maximum rated output current for more then 10 seconds continuously will result to output shutdown.
For peak current capable model, Over Current Protection triggers at 105% of Maximum Peak Output Current or more with 200VAC input line.

(*8) OVP circuit will shut down output, manual reset (power cycle) or ON/OFF CNT signal reset.

(*9) At 100/200VAC, nominal output voltage and maximum output current.

(*10) Measured by the each measuring method of UL, CSA, EN and DENAN (at 60Hz), Ta=25 .

(*11) Ratings - Derating at standard mounting.
- Load (%) is percent of maximum output power or maximum output current, whichever is greater.
- As for other mountings, refer to derating curve.

(*12) As for DENAN, built to meet at 100VAC.

(*13) Peak output current is less than 10 seconds, and duty 35% max. (200VAC Line only)

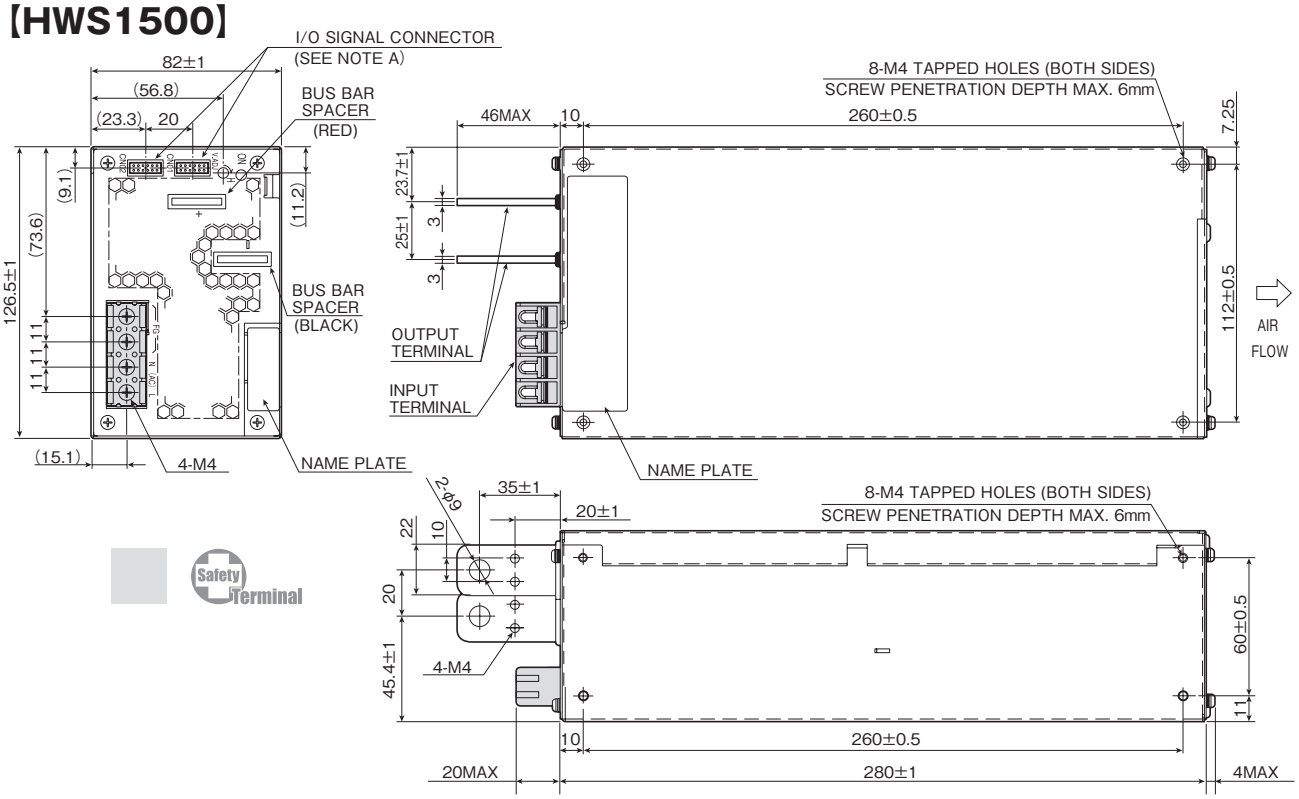
●Recommended EMC Filter

RSEN-2030

Please refer to "TDK-Lambda EMC Filters" catalog.

Outline Drawing

【HWS1500】



[unit: mm]
[Chassis material:SPCC-SD]

NOTES

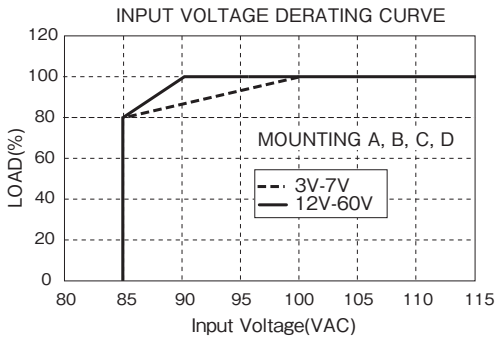
A : I/O SIGNAL CONNECTOR

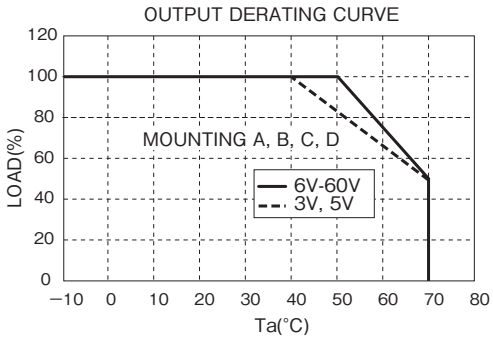
CONNECTOR	:	S12B-PHDSS (LF) (SN)	(JST)
MATCHING HOUSING	:	PHDR-12VS	(JST)
MATCHING CONTACT	:	SPHD-002T-P0.5 (AWG28 - 24)	(JST) OR
		SPHD-001T-P0.5 (AWG26 - 22)	(JST) OR
		BPHD-001T-P0.5 (AWG26 - 22)	(JST)
HAND CRIMPING TOOL	:	YRS-620 (SPHD-002T-P0.5)	(JST)
		YC-610R (SPHD-001T-P0.5)	(JST)
		YC-610R (BPHD-001T-P0.5)	(JST)

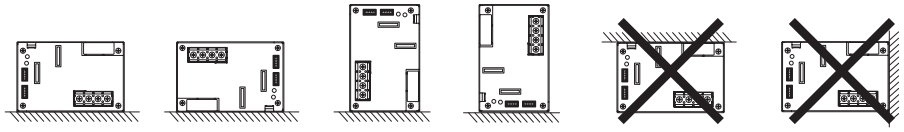
ACCESSORIES

* ATTACHED CONNECTOR
  SHORTING +S ～ +V, -S ～ -V, PV ～ REF & CNT ～ TOG ATTACHED ON CN01 AT SHIPMENT
* A separate connector not included is required in order to utilize the power supply function.

Output Derating







*It cannot be used even the product is flipped vertically.

HWS1800T Specifications (Read instruction manual carefully, before using the power supply unit.)

ITEMS/UNITS			MODEL	HWS1800T-3	HWS1800T-5	HWS1800T-6	HWS1800T-7	HWS1800T-12	HWS1800T-15	HWS1800T-24	HWS1800T-36	HWS1800T-48	HWS1800T-60
Input	Voltage Range	(*2)	V	3φ AC170 - 265									
	Frequency	(*2)	Hz	47 - 63									
	Power Factor (200VAC)(typ)	(*1)		0.94									
	Efficiency (200VAC)(typ)	(*1)	%	75	81	82	84			88		90	
	Current (200VAC)(typ)	(*1)	A	4.5	6.0					7.0			
	Inrush Current (200VAC)(typ)	(*3)	A	40									
	Leakage Current (240VAC)	(*10)	mA	2.6 max									
Output	Nominal Voltage		VDC	3.3	5	6	7.5	12	15	24	36	48	60
	Maximum Current		A	300		250	200	125	100	75	50	37.5	30
	Maximum Peak Current	(*12)	A	-		300	240	150	120	105	70	52.5	42
	Maximum Power		W	990	1500					1800			
	Maximum Peak Power	(*12)	W	-	1800					2520			
	Maximum Line Regulation	(*5)	mV	36			40	48	60	96	144	192	240
	Maximum Load Regulation	(*6)	mV	60				72	90	144	216	288	360
	Temperature Coefficient			Less than 0.02%/℃									
	Maximum Ripple & Noise (*4)	+25 to +71℃	mVp-p	150				200		250		300	400
		0℃	mVp-p	200						250		300	400
		-10℃	mVp-p	220				250		300		400	600
	Hold-up Time (typ)	(*9)	ms	20						18			
	Voltage Adjustable Range		VDC	2.64-3.96	4.0-6.0	4.8-7.2	6.0-9.0	9.6-14.4	12.0-18.0	19.2-28.8	28.8-43.2	38.4-52.8	48.0-66.0
Function	Over Current Protection	(*7)	A	>315.0		>303.0	>242.4	>151.5	>121.2	>106.0	>70.7	>53.0	>42.4
	Over Voltage Protection	(*8)	VDC	4.12-4.62	6.25-7.0	7.5-8.4	9.37-10.5	15.0-17.4	18.7-21.8	30.0-34.8	45.0-49.7	55.2-60.0	69.0-75.0
	Remote Sensing			Possible									
	Remote ON/OFF Control			Possible									
	Output Voltage External Control			Possible									
	Parallel Operation			Possible									
	Series Operation			Possible									
	Monitoring Signal			PF (Open collector output)									
	Line DIP			Built to meet SEMI-F47									
Environment	Operating Temperature	(*11)	℃	-10 to +71, Start up -20 to +71									
		-10 to +40℃	W	990	1500					1800			
		+50℃	W	825	1250	1500				1680			
		+60℃	W	660	1000	1125				1300			
		+71℃	W	495	750					900			
	Storage Temperature		℃	-30 to +85									
	Operating Humidity		%RH	10 - 90 (No Condensing)									
	Storage Humidity		%RH	10 - 95 (No Condensing)									
	Vibration			At no operating, 10 - 55Hz (sweep for 1min.) 19.6m/s² constant, X, Y, Z 1hour each.									
	Shock (In package)			Less than 196.1m/s²									
	Cooling			Forced air by blower fan									
Isolation	Withstand Voltage			Input - FG : 2kVAC (20mA), Input - Output : 3kVAC (20mA), Output-FG : 500VAC (300mA), (60V model 651VAC(390mA)), Output-CNT:100VAC (100mA) for 1min									
	Isolation Resistance			More than 100MΩ Output - FG : 500VDC More than 10MΩ Output - CNT 100VDC at 25℃ and 70%RH									
Standards	Safety Standards			Approved by UL60950-1, CSA C22.2 No.60950-1, EN60950-1									
	EMI			Built to meet EN55011/EN55022-A, FCC-ClassA, VCCI-ClassA.									
	Immunity			Built to meet IEC61000-4-2(Level 2,3), -3(Level 3), -4(Level 3), -5(Level 3,4), -6(Level 3), -8(Level 4), -11									
Mechanical	Weight (typ)		g	4000				3800					
	Size (W x H x D)		mm	126.5 x 82 x 280 (Refer to outline drawing)									

(*1) At Ta=25℃ and maximum output power.

(*2) For cases where conformance to various safety specs (UL, CSA, EN) are required, input voltage range will be 200 - 240VAC (50/60Hz).

(*3) First in-rush current. Not applicable to the first 0.2ms in-rush current flowing into the power supply noise filter.

(*4) Measure with JEITA RC-9131A probe, bandwidth of scope: 100MHz.
(At 100uF electric capacitor and 0.47uF film capacitor on the test fixture board.)
Ripple noise spec for ambient temperature between -10 to 25 is a linearity value with respect to the -10 degrees C and 25 degrees C specs.

(*5) 170 - 265VAC, constant load.

(*6) No load-full load, constant input voltage.

(*7) Constant current limit with automatic recovery. Over current condition for more than 5 seconds will cause the output to shutdown.
Output current exceeding maximum rated output current for more then 10 seconds continuously will result to output shutdown.

(*8) OVP circuit will shut down output, manual reset (power cycle) or ON/OFF CNT signal reset.

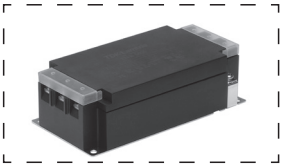
(*9) At 200VAC(50/60Hz), nominal output voltage and maximum output current.

(*10) Measured by the each measuring method of UL, CSA and EN (at 60Hz), Ta=25℃.

(*11) Ratings - Derating at standard mounting.
- As for other mountings, refer to derating curve.

(*12) Peak output current is less than 10 seconds, and duty 35% max.

●Recommended EMC Filter

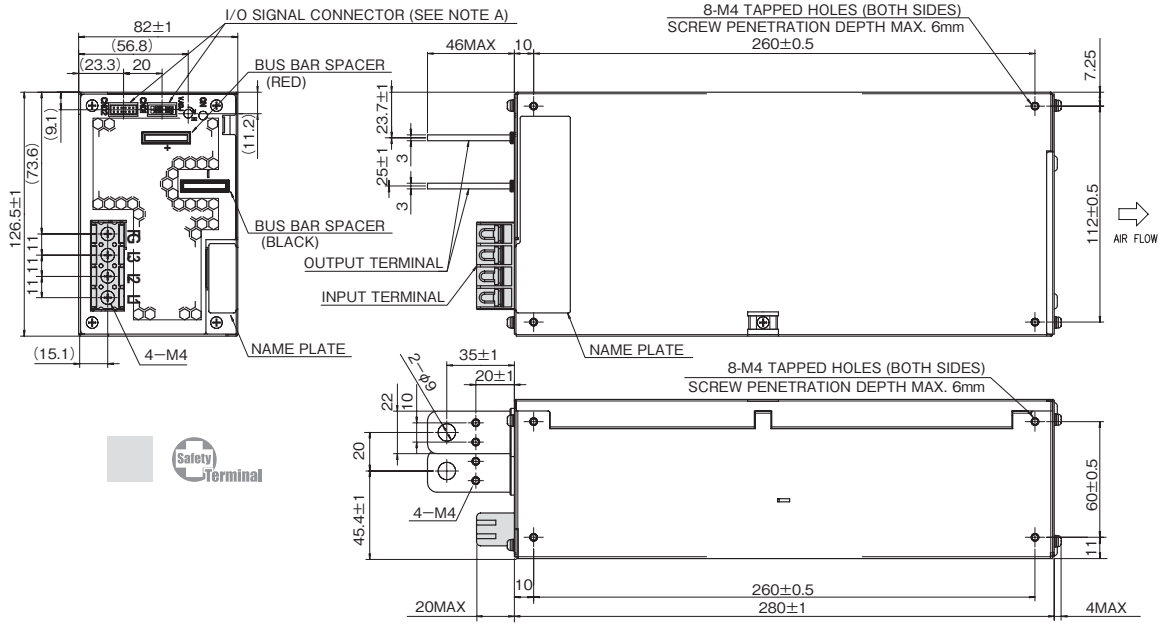


RTEN-5020

Please refer to "TDK-Lambda EMC Filters" catalog.

Outline Drawing

【HWS1800T】



[unit: mm]
[Chassis material:SPCC-SD]

NOTES

A : I/O SIGNAL CONNECTOR

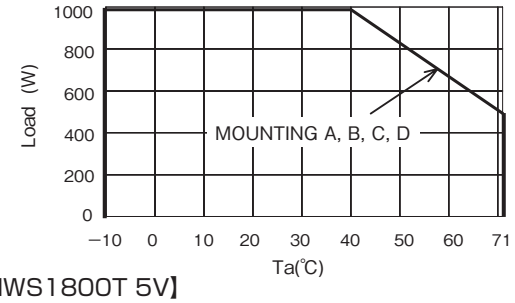
CONNECTOR	:	S12B-PHDSS (LF) (SN)	(JST)
MATCHING HOUSING	:	PHDR-12VS	(JST)
MATCHING CONTACT	:	SPHD-002T-P0.5 (AWG28 - 24)	(JST) OR
		SPHD-001T-P0.5 (AWG26 - 22)	(JST) OR
		BPHD-001T-P0.5 (AWG26 - 22)	(JST)
HAND CRIMPING TOOL	:	YRS-620 (SPHD-002T-P0.5)	(JST)
		YC-610R (SPHD-001T-P0.5)	(JST)
		YC-610R (BPHD-001T-P0.5)	(JST)

ACCESSORIES

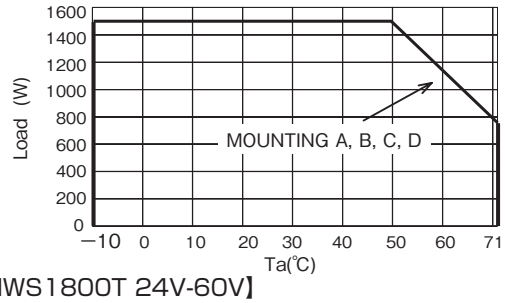
* ATTACHED CONNECTOR (3 - 7V)
  SHORTING +S ～ (+), -S ～ (-), PV ～ REF & CNT ～ TOG ATTACHED ON CN01 AT SHIPMENT
* ATTACHED CONNECTOR (12 - 60V)
  SHORTING +S ～ +V, -S ～ -V, PV ～ REF & CNT ～ TOG ATTACHED ON CN01 AT SHIPMENT
* A separate connector not included is required in order to utilize the power supply function.

Output Derating

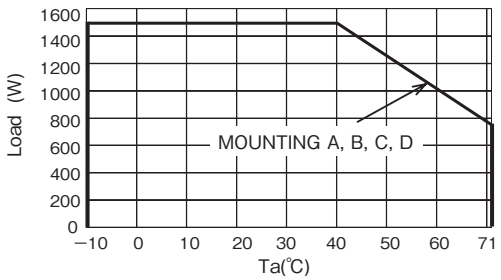
【HWS1800T 3V】



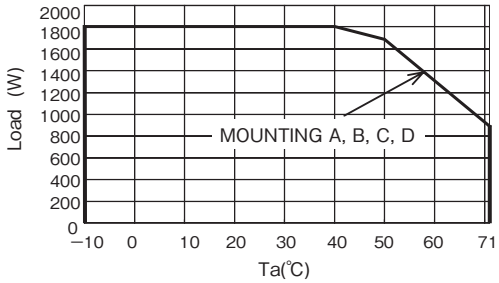
【HWS1800T 6V-15V】

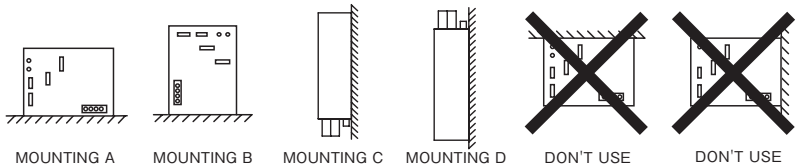


【HWS1800T 5V】



【HWS1800T 24V-60V】



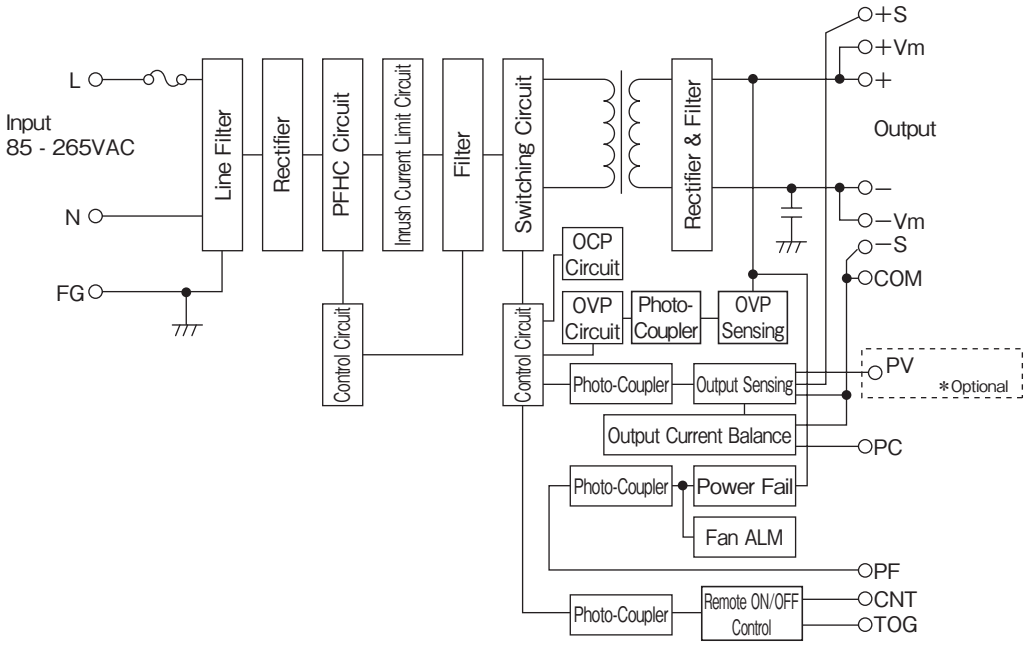


*It cannot be used even the product is flipped vertically.

TDK·Lambda

Block Diagram

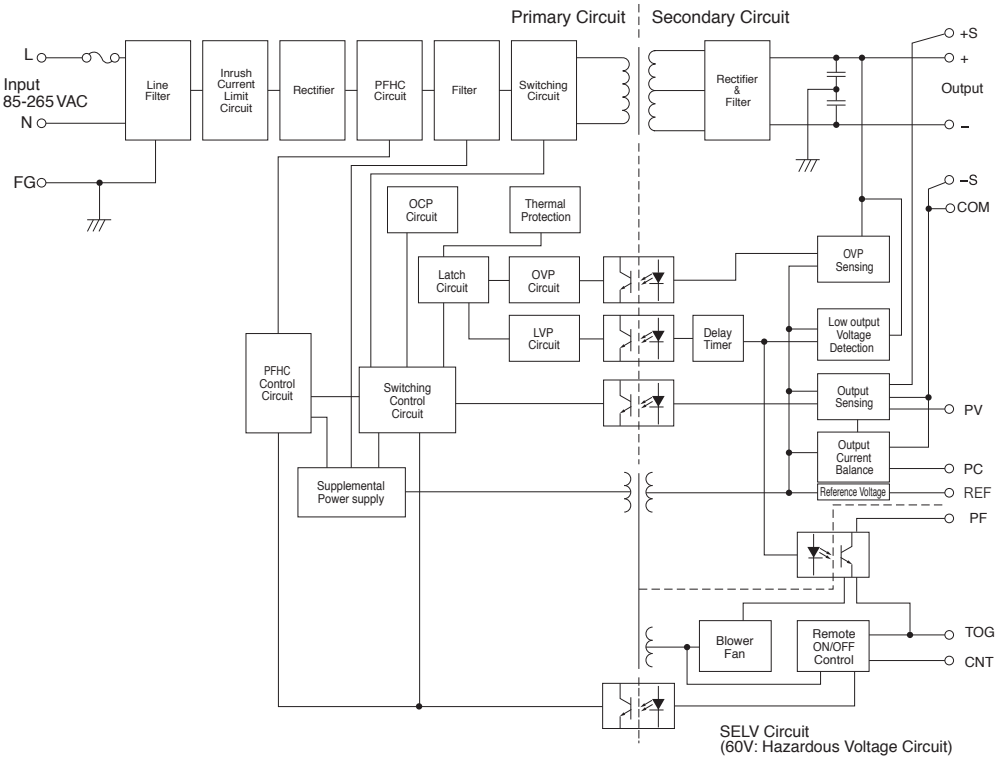
[HWS300, HWS600]



● Circuit topology, switching frequency
Cascade forward topology 190kHz（fixed）
PFHC circuit : active filter
HWS300 : 80kHz（fixed）, HWS600 : 90kHz（fixed）

● Fuse rating :
HWS300：10A, HWS600：15A

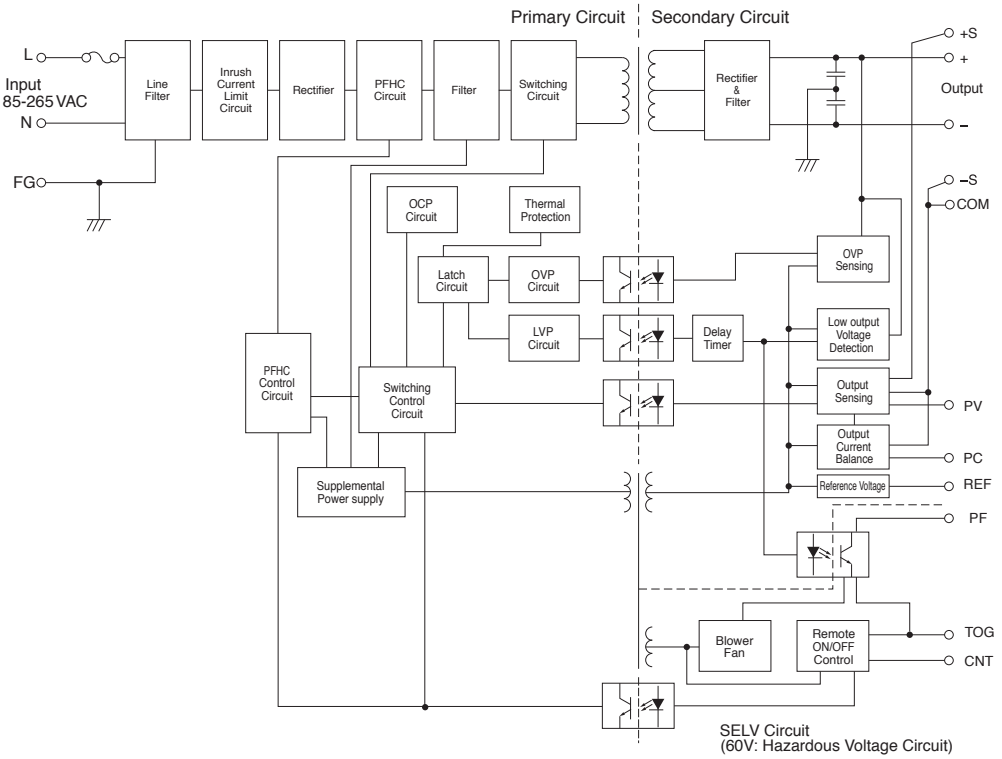
[HWS1000]



●SWITCHING CIRCUIT
HALF-BRIDGE CONVERTER 46kHz (fixed)
●PFHC CIRCUIT ACTIVE FILTER 63kHz (fixed)
●FUSE RATING 20A
●FG FUNCTION GROUND

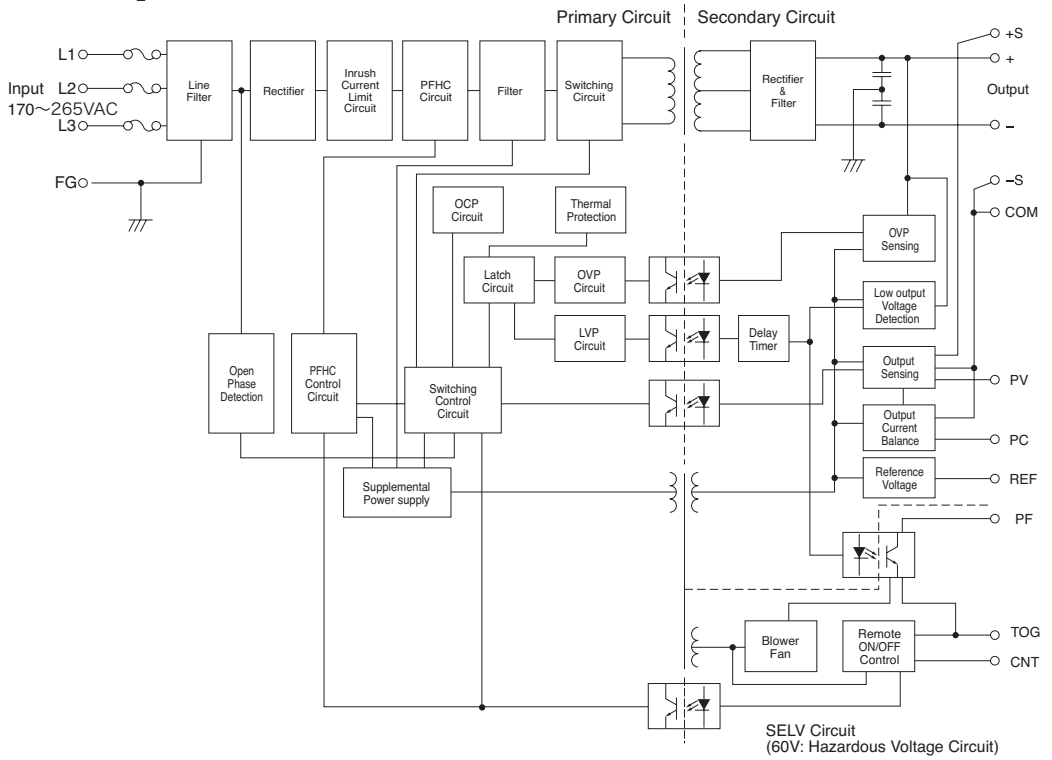
Block Diagram

【HWS1500】



● Switching circuit
Half - bridge converter : 3 - 5V 45kHz (fixed), 6 - 7V 55kHz (fixed), 12 - 60V 70kHz (fixed)
● PFHC circuit : Active filter 65kHz (fixed)
● Fuse rating : 30A
● FG : Function ground

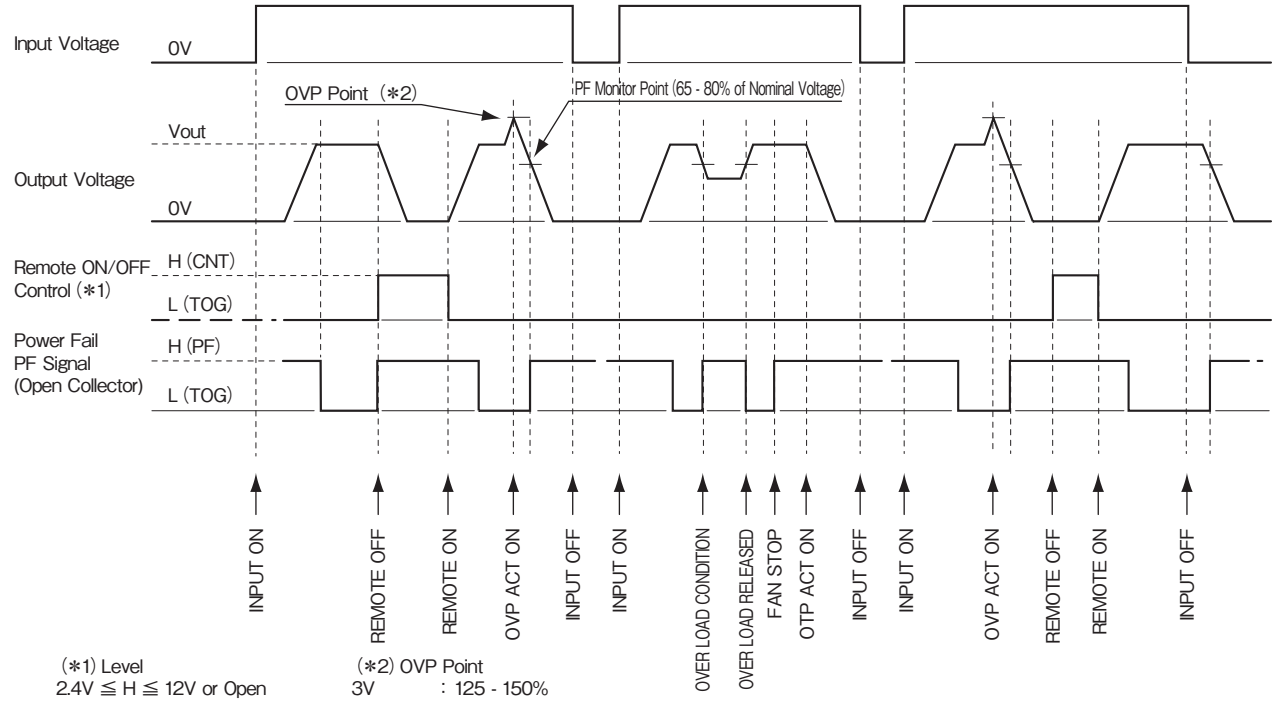
【HWS1800T】



● Switching circuit
Half - bridge converter : 3 - 5V 45kHz (fixed), 6 - 7V 55kHz (fixed), 12 - 60V 70kHz (fixed)
● PFHC circuit : Active filter 65kHz (fixed)
● Fuse rating : 20A
● FG : FUNCTION GROUND

Sequence Time Chart

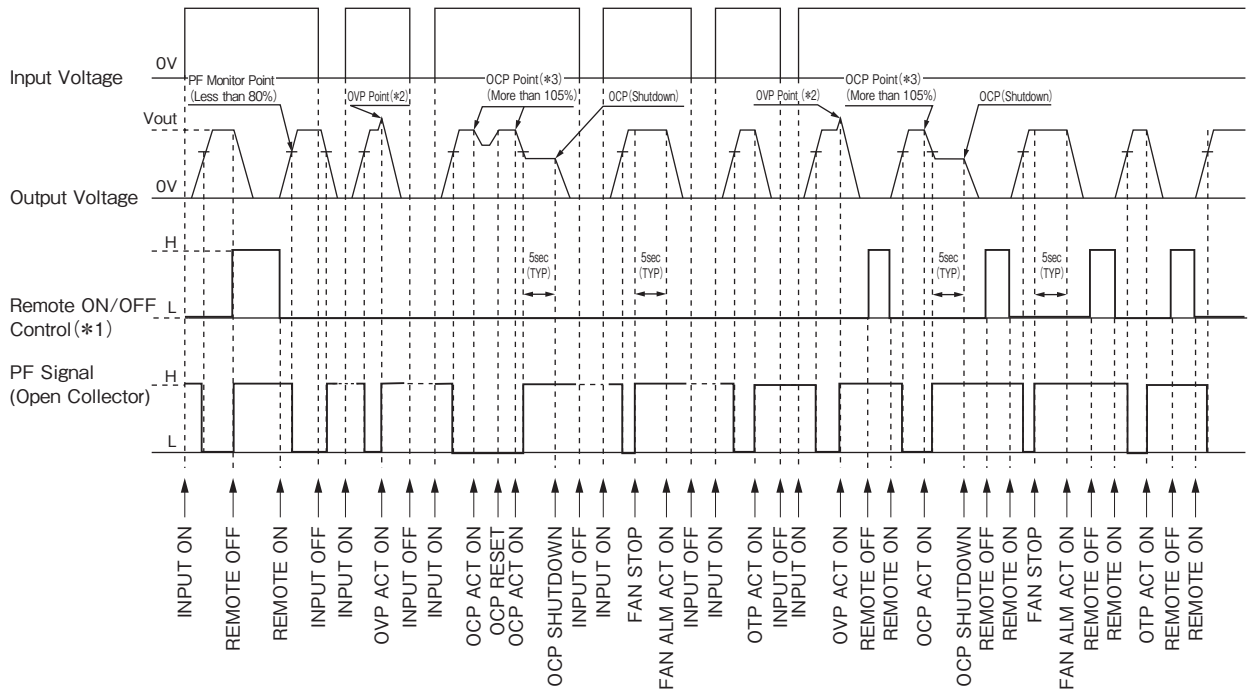
[HWS300, HWS600]



(*1) Level
2.4V ≦ H ≦ 12V or Open
0V ≦ L ≦ 0.8V or Short

(*2) OVP Point
3V : 125 - 150%
5 - 24V : 125 - 145%
48V : 115 - 135%

[HWS1000]



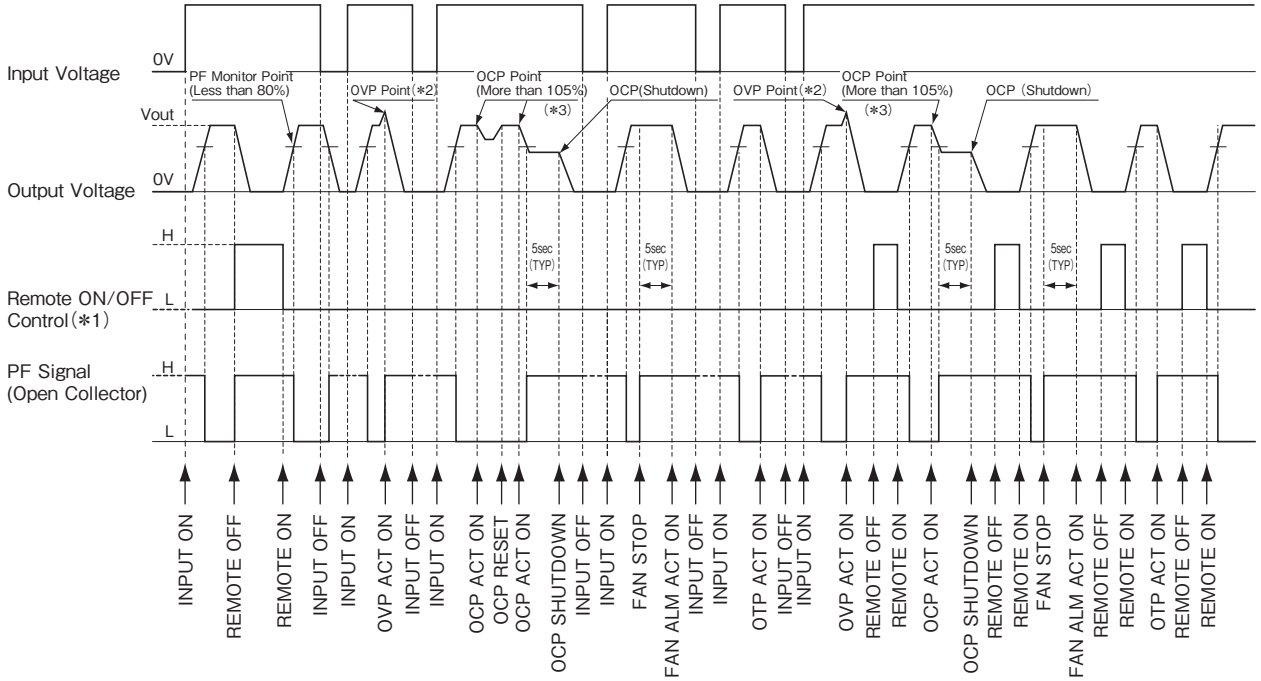
(*1) Level
2.4V ≦ H ≦ 12V or Open
0V ≦ L ≦ 0.8V or Short

(*2) OVP Point
3 - 7V :125 - 140%
12, 15, 24V:125 - 145%
36V :125 - 138%
48, 60V :115 - 125%

(*3) OCP Point (7V - 60V Model, Input voltage AC180 - 265V)
- Peak current: 120%(7V), 114%(12V, 15V), 127%(24V - 60V)
  Peak current is less than 10 seconds, and duty 35% max.
- Overload exceeding 105%(without output dropping Situation) continuously for more than 10 seconds will result to output shutdown.
  Meanwhile, overload exceeding 105%(with output dropping) continuously for more than 5 seconds will result to output shutdown.
- OCP Point: More than 120%(7V), More than 114%(12V, 15V), More than 127%(24V - 60V)

Sequence Time Chart

[HWS1500]



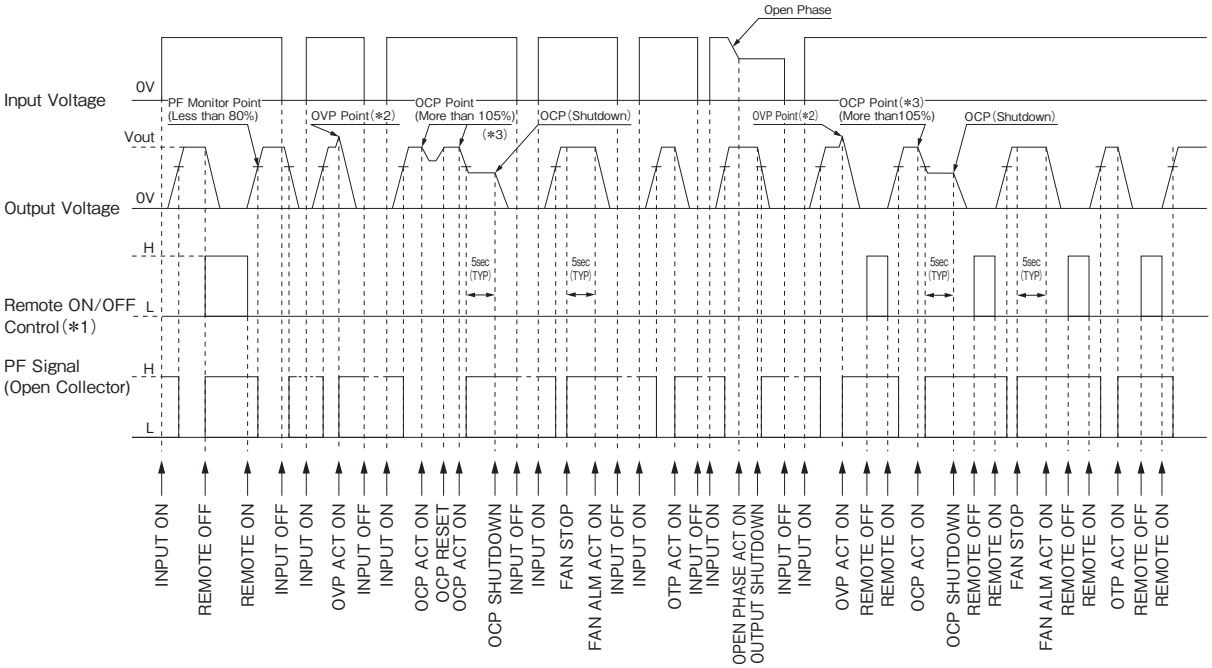
(*1) Level
2.4V ≦ H ≦ 12V or Open
0V ≦ L ≦ 0.8V or Short

(*2) OVP Point

3 - 7V	:	125 - 140%
12, 15, 24V	:	125 - 145%
36V	:	125 - 138%
48V	:	115 - 135%
60V	:	115 - 125%

(*3) OCP Point (6V 7V, 24V, 36V, 60V Model, Input voltage AC180 - 265V)
- Peak current: 120%(6V 7V), 150%(24V, 36V, 60V)
  Peak current is less than 10 seconds, and duty 35% max.
- Overload exceeding 105%(without output dropping situation) continuously for more than 10 seconds will result to output shutdown.
- Meanwhile, overload exceeding 105%(with output dropping) continuously for more than 5 seconds will result to output shutdown.
- OCP Point: More than 120%(6V 7V), More than 150%(24V, 36V, 60V)

[HWS1800T]



(*1) Level
2.4V ≦ H ≦ 12V or Open
0V ≦ L ≦ 0.8V or Short

(*2) OVP Point

3 - 7V	:	125 - 140%
12,15,24V	:	125 - 145%
36V	:	125 - 138%
48,60V	:	115 - 125%

(*3): OCP Point
- Peak current: 120% (6V - 15V), 140% (24V - 60V)
  Peak current is less than 10 seconds, and duty 35% max.
- Overload exceeding 105%(without output dropping situation) continuously for more than 10 seconds will result to output shutdown.
  Meanwhile, overload exceeding 105%(with output dropping) continuously for more than 5 seconds will result to output shutdown.
- OCP Point: More than 120% (6V - 15V), More than 140% (24V - 60V)

HWS300, 600 Series Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read the following precautions thoroughly before using this power supply unit.
Pay attention to all warnings and cautions before using the unit. Incorrect usage could lead to an electric shock, damage or a fire hazard.

⚠ WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void warranty.
- Do not touch the internal components, they may have high voltage or high temperature. You may get electric shock or burned.
- When the unit is operating, keep your hands and face away from it; an accident may injure you.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock.
  In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire, when using the unit under such condition.
- Do not operate these units at the condition of condensation. It may cause fire and electric shock.
- The outputs of these products must be earthed in the end use equipment to maintain SELV.
  If the outputs are not earthed, they must be considered hazardous and must not be made user accessible.

⚠ CAUTION

- This power supply is primarily designed and manufactured to use and enclose in other equipment.
- This power supply unit has a built-in fan for air-cooling. Do not block air intake and exhaust. It might cause fire.
- Input voltage, output current, output power, ambient temperature and ambient humidity should be within specifications, otherwise the unit will be damaged.
- The unit might be broken down by accident or unexpected situation. For application equipment, which requires very high reliability (nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not make an improper wiring to input and output terminals. It may cause damage.
- Do not use in environment such as strong electromagnetic field, erosive gas etc, or any environment where conductive foreign substance may enter.
- Do not operate and store this unit at the condition of condensation. In such case, waterproof treatment is necessary.
- Do not operate this unit after it falls down.
- The output voltage of this power supply is considered to be a hazardous energy level, and must not be accessible to an operator.

Notes for HWS30-150/ME IEC/EN/UL60601-1

⚠ NOTES

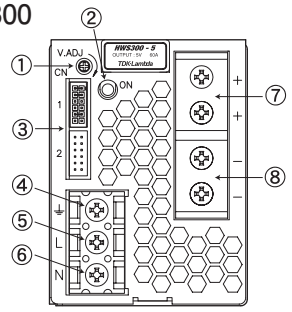
- The product should be completely enclosed in the application according to the specifications, and contact to the I/O part with the patient be limited. Be careful when designing the outline. Please refer to section 16, IEC/EN/UL60601-1.
- This product is not suitable for the use of the combustible narcotic that oxygen or the nitrous oxide mixed.
- The signal port connects only the device that suits IEC/EN/UL60601-1.
- It is necessary to fuse it in two poles of the main power supply in the overall equipment into which this product is built excluding the permanent installation type equipment defined by IEC/EN/UL60601-1 section 57.6. The fuse is installed in the monopole of the input of this product (live line).
- Between I/O of this product is evaluated as the basic insulation by IEC/EN/UL60601-1. Please add further insulation for safe contact to the output part.
- Please refer to local regulations for the disposal of the product that passes the life.
- The leake current of this product in normal condition is 500uA or less. (At input voltage 230VAC.) The unit is suitable for medical equipment as provided by IEC/EN/UL60601-1. In the application according to the UL60601 requirement, it is assumed that surfaces of all equipment is assembled with the insulating materials.
- This product is not evaluated by IEC/EN/UL60601-1-2(EMC). However, EMC test data is available at TDK-Lambda.

1. Terminal Explanation

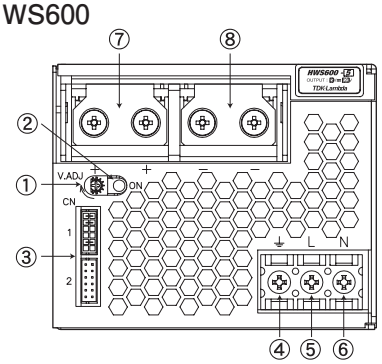
Please pay extra attention to the wiring. Incorrect connection will damage the power supply.

1 Front Panel Explanation

● HWS300



● HWS600

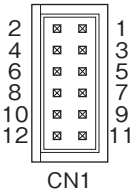


① V.ADJ: Output voltage adjustment trimmer.
(The output voltage rises when a trimmer is turned clockwise.)
② ON: Output (Power On) indication LED
(The indicator turns on when the power supply output is in normal operating condition.)
③ CN1, CN2: Remote sensing, ON/OFF control signal, Current balance signal, Power fail signal, Output voltage external control signal. (Refer to 2-2.)
④ ⏚: Protective Earth (Frame ground), M4 screw.
⑤ AC input terminal L: Live Line (Fuse in line), M4 screw.
⑥ AC input terminal N: Neutral line, M4 screw.
⑦ +: + Output terminal
(HWS300: M4 screw x 2 / HWS600: M5 screw x 2)
⑧ −: − Output terminal
(HWS300: M4 screw x 2 / HWS600: M5 screw x 2)

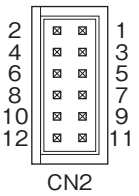
2 CN1, CN2 Connector pin Configuration and Function

CN1 and CN2 are same pin configuration and function.
They are connected to each other in this power supply unit.
When the pin of CN1 side is shorted, the same function pins of CN2 side are also shorted.
Please note that the function cannot be separately set with CN1 and CN2.

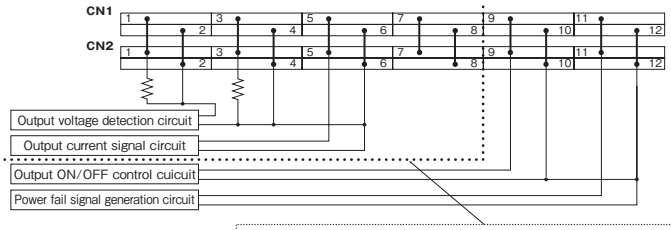
Pin No	Configuration	Function
1	+ Vm	+Output monitor terminal. Connected to +Output terminal in this Power supply unit. (+Vm terminal can not supply load current.)
2	+ S	Remote sensing terminal for +output. (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to +Vm terminal when remote sensing function unnecessary.)
3	− Vm	-Output monitor terminal. Connected to -Output terminal in this Power supply unit. (-Vm terminal can not supply load current.)
4	− S	Remote sensing terminal for -output. (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to -Vm terminal when remote sensing function unnecessary.)
5	PC	Current balance terminal. (For output current balancing in parallel operation.)
6	COM	GND for PC and PV signals.
7	PV (Optional)	Output voltage external control terminal. (For power supply output voltage control with an external voltage. Standard models don't have this function and indicate NC mark at panel.
8	NC	No connect
9	CNT	Remote ON/OFF control terminal. (Power supply ON/OFF control with an external signal.)
10	TOG	GND for CNT and PF signals. (Same as Pin No.12)
11	PF	Power fail signal (PF signal) output terminal. (As the output voltage drops, or FAN stops and AC input voltage down, "Power Fail" terminal will output "High".
12	TOG	GND for CNT and PF signals. (Same as Pin No.10)



CN1



CN2



* Output ON/OFF control circuit and the power fail signal circuit are insulated with other circuits in the power supply (insulating voltage AC100V).

CN1, CN2 Connector & Housing & Terminal Pin

PART DESCRIPTION	PART NAME	MANUFACT
PIN HEADER	S12B-PHDSS	JST
SOCKET HOUSING	PHDR-12VS	JST
TERMINAL PINS	SPHD-002T-P0.5 (AWG28-24) SPHD-001T-P0.5 (AWG26-22)	JST
HAND CRIMPING TOOL	YRS-620 (SPHD-002T-P0.5) YC-610R (SPHD-001T-P0.5)	JST

2. Terminal Connection Method

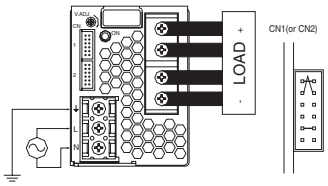
Please pay extra attention to the wiring. Incorrect connection will damage the power supply.

- When connecting input and output wiring, and CN1, CN2, input AC-Line should be off.
- Input wiring and output wring shall be separated to improve noise sensibility.
- The protective earth (PE) must be connected to the ⏚ terminal or chassis.
- Remote sensing lines shall be twisted or used with shielded wired.
- Remote ON/OFF control lines shall be twisted or used shielded wires. Separate from load line.
- Output current of each terminal screw shall be less than 40A for HWS300. And shall be less than 60A for HWS600.

HWS300 Panel Side (Common HWS600)

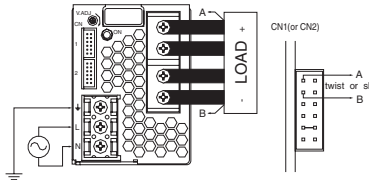
Basic connection (Local sensing)

Connect "+S" terminal to "+Vm" terminal and "−S" terminal to "−Vm" terminal . Connect "CNT" terminal to "TOG" terminal with the attached connector.



Remote sensing required

Connect "+S" terminal to "+" terminal of load and "-S" terminal to "-" output terminal of load with wires.



Attached connector when shipping

Red Black Yellow

1	3	5	7	9	11
2	4	6	8	10	12

Twisted wire

Connecting circuit with CN1 or CN2 connector

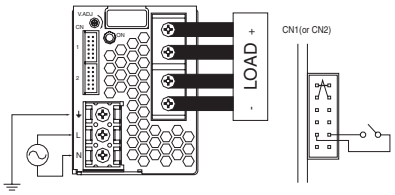
1	3	5	7	9	11
2	4	6	8	10	12

"+" of load

"-" of load

ON/OFF control required

"TOG" terminal is ground for "CNT" terminal.

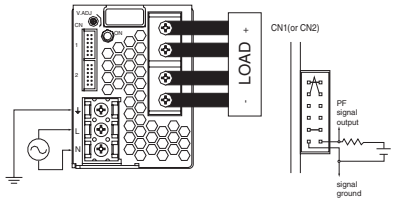


Connecting circuit with CN1 or CN2 connector

1	3	5	7	9	11
2	4	6	8	10	12

PF signal output required

Open collector method shown below shall be used.
"TOG" terminal is ground for "PF" terminal.



Connecting circuit with CN1 or CN2 connector

1	3	5	7	9	11
2	4	6	8	10	12

PF signal output

signal ground

3. Functions and Precautions

1 Input Voltage Range

Input voltage range is single phase 85-265VAC (47-63Hz) or 120-330VDC. Input voltage, which is out of specification, may cause unit damage. Rated input voltage for safety standard application is 100VAC-240VAC (50/60Hz).

2 Output Voltage Range

Output voltage is set to the rated value at shipment. V.ADJ trimmer on the front panel side may be used to adjust the output voltage within the range specified.
Output voltage range is within ±20% of rated output voltage (48V Output Model: -20% to +10%).
To turn the trimmer clockwise, the output voltage will be increased. Take note when the output voltage is increased excessively, over voltage protection (OVP) function may trigger and output voltage will be shut down.

3 Over Voltage Protection (OVP)

The OVP function (inverter shutdown method, manual reset type) is provided. OVP function operates within 125-145% of the rated output voltage value (48V type: 115-135%), and the output will be shut down when OVP function triggers. To reset OVP, remove the input of power supply for a few minutes, and then re-input. Or, use CNT reset (remote ON/OFF: OFF to ON). OVP value is fixed and not to be adjusted externally.
Never apply more than rated output voltage to output terminal, which may lead damage. In the case of inductive load, use decoupling diode at output line.

4 Over Current Protection (OCP)

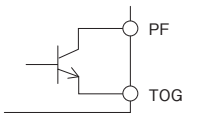
The OCP function is provided. OCP characteristic is constant current limiting, (less than 5V output model: with Hiccup operation) automatic recovery. OCP function operates when the output current exceeds 105% (24V output model: 119%) of maximum DC output current specification. The output will be automatically recovered when the overload condition is canceled. Never operate the unit under over current or shorted conditions for more than 30 seconds, which may lead damage. OCP setting is fixed and not to be adjusted externally.

5 Over Temperature Protection (OTP)

The OTP function (manual reset type) is provided. When ambient or internal temperature rises abnormally, OTP function operates and output will be shut down. After shut down, remove the input and cool it down to reset OTP.
Then re-input.

6 Low Output Detection Circuit (PF)

Low output voltage detection circuit is provided. Power Fail (PF) signal will turn "High" level to indicate the abnormal status when the output voltage becomes within 65-80% of rated value caused by either the drop or brownout of the input voltage or OCP, OVP and OTP function operation. When the built-in FAN motor of this power supply unit stops, PF signal will turn to "H". The PF signal is isolated from input and output by a photo-coupler. It uses the open collector method shown below.

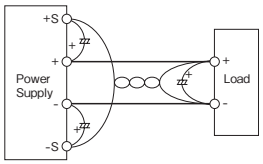


V_{CE} max: 30V
I_C max: 20mA

7 Remote Sensing (+S, -S terminal)

This function compensates voltage drop of wiring from output terminals to load terminals. Connect "+S" terminal to "+" terminal of load and "-S" terminal to "-" terminal of load with sensing wires. The total line voltage drop (+ side line and - side line) shall be less than 0.3V. In case that sensing lines are too long, it is necessary to put an electrolytic capacitor in following 3 places;

1) across the load terminal,
2) between "+S" terminal and "+" terminal,
3) between "-S" terminal and "-"terminal.



When the function of remote sensing is not used, connect +S terminal to +Vm terminal, and –S terminal to –Vm terminal by the attachment connector.
If remote sensing terminals are opened, the stability and the accuracy of the output deteriorated. Therefore, terminal +S, -S must be connected.

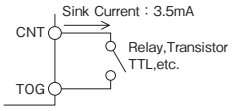
8 Remote ON/OFF Control

Remote ON/OFF control is provided.
Using this function, output on/off is allowed to control without input voltage on/off. The output is turned to ON when TOG and CNT terminals are shorted, and the output is turned to OFF when these terminals are opened. When the function is not used, connect TOG and CNT terminals. The standards for this function are as follows. "TOG" terminal is return for "CNT" terminal.

(1) TTL compatible. The maximum input voltage to CNT terminal is 12V, and the maximum allowable reverse voltage is -1V. The sink current for CNT terminal is 3.5mA.
(2) A switch and relay or a transistor can be used as ON/OFF switch.
(3) Remote ON/OFF control circuit is isolated from the input and output by a photo-coupler and can be controlled regardless of the output potential (+ or -). Connect TOG terminal to ground of control signal.

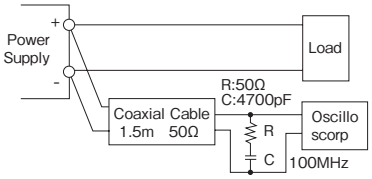
The mode of control

CNT Level for TOG Terminal	Output	Built-in Fan
Short or L (0V - 0.8V)	ON	Rotate
Open or H (2.4V - 12V)	OFF	Stop



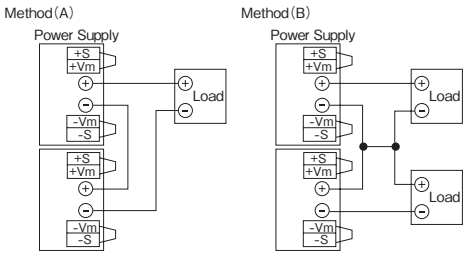
9 Output Ripple & Noise

The standard specification for maximum ripple value is measured specified measurement circuit (JEITA-RC9131A). When load lines are longer, ripple becomes larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal. The output ripple cannot be measured accurately if the probe ground lead of oscilloscope is too long.



10 Series Operation

For series operation, both method (A) and (B) are possible.
There might be a step in the output rise waveform during series operation.

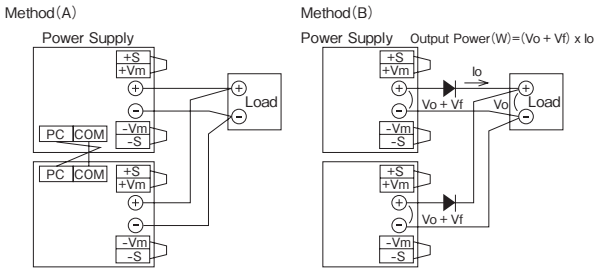


11 Parallel Operation

Current balancing function is provided. Both operations mode (A) and (B) are possible.

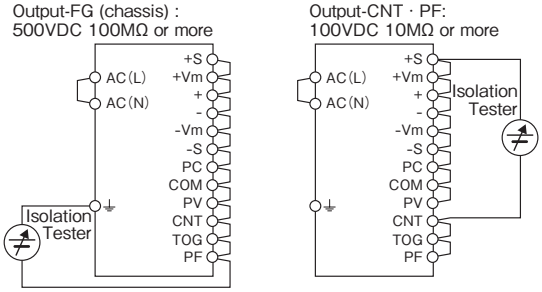
(A) To Increase the Output Current
Correct PC to PC terminal and COM to COM terminal, the current balancing function activates and output current of each power supply is equivalently supplied to load. Wires to PC terminals, COM terminals shall be as short as possible and same length and twisted.
1. Adjust the output voltage of each power supply to be same value within 1% or 100mV whichever is smaller.
2. Use same length and type of wires for all load lines.
3. Use the power supply within the rated output current for all paralleled models.
4. Parallel operation is possible up to 5 units.

(B) To Use as a Backup Power Supply
1. Adjust the output voltage of each power supply to be same value.
2. Set power supply output voltage higher by the forward voltage drop of diode.
3. Use within the specifications for output voltage and output current.



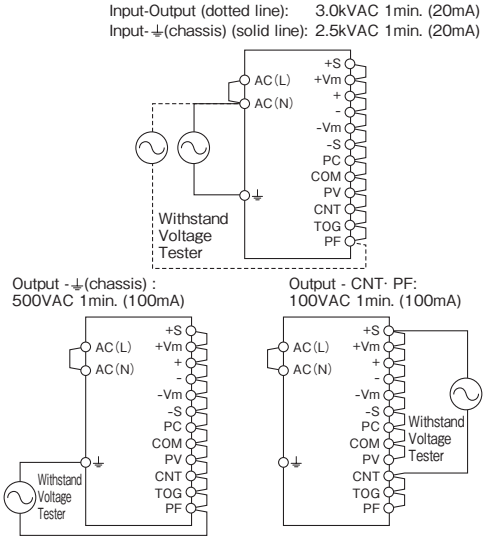
12 Isolation Test

Isolation resistance between output and ⏚(chassis) shall be more than 100MΩ at 500VDC and between output and CNT·PF shall be more than 10MΩ at 100VDC. For safety operation, voltage setting of DC isolation tester must be done before the test. Ensure that it is fully discharged after the test.



13 Withstand Voltage

This series is designed to withstand 3.0kVAC between input and output, 2.5kVAC between input and ⏚(chassis), 500VAC between output and ⏚(chassis), and 100VAC between output and CNT·PF terminal each for 1 minute. When testing withstand voltage, set current limit of withstand voltage test equipment at 20mA.
(Output-⏚(chassis) and Output-Control: 100mA).
The applied voltage must be gradually increased from zero to testing value and then gradually decreased for shut down. When timer is used, the power supply may be damaged by high impulse voltage at timer switch on and off. Connect input and output as follows.



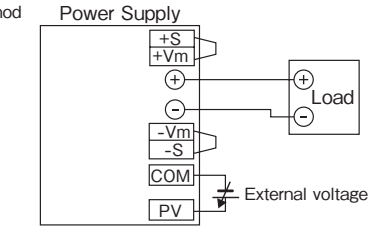
*This product have monolithic ceramic capacitor in secondary circuit to frame ground.
Some of the withstand voltage tester may generate high voltage at the matching with monolithic ceramic capacitor and may cause the unit damage.

So, please check the waveform of test voltage.

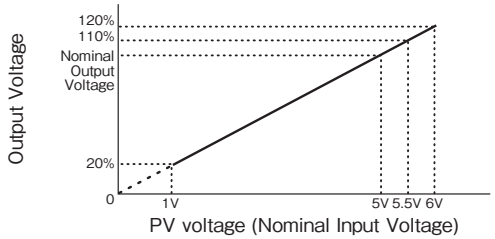
14 Output Voltage External Control(PV)

Output voltage external control function is available as option with model name followed by "/PV". Output voltage can be varied by applying an external voltage (1–6V) to "PV" terminal and "COM" terminal. Note if an external voltage is not applied, there will be no output. Please consider the following characteristics.

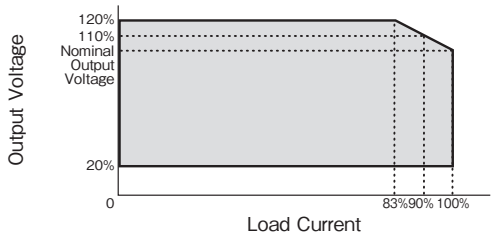
Connection method



Output Voltage Linearity



Output Voltage Derating



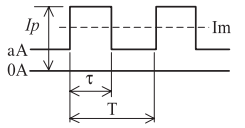
Note 1. Regarding output voltage adjustment below 20%, please consult our sales.

Note 2. For 48V output model only, spaces below must be followed. Limit output voltage variation range at 20%-110%.
At PV voltage variation 1V-5.5V.

15 Output Peak Current

For 24V output model, please meet the following condition. Reduce peak current value according to output derating as section 5-1.

Input Voltage range:	AC180V-265V
Continuous Peak output time (τ):	Within 10 seconds
Peak output current (*Ip*):	Within the rated peak output current
Average DC output current (Im):	Within the rated output current



$$Im = \frac{(Ip - a) \times \tau}{T} + a \leq Iav$$

Duty: up to 35(%)

$$Duty = \frac{\tau}{T} \times 100(\%)$$

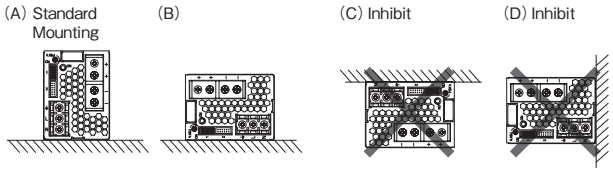
Ip : Peak output current(A)
Iav : Rated output current (A)
Im : Average output current (A)
τ : Peak current pulse width (sec)
T : Period (sec)

4. Mounting Directions

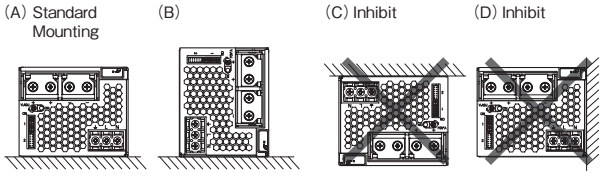
1 Output Derating according to the Mounting Directions

Recommended standard mounting method is (A). Method (B) is also possible. Refer to the derating below.

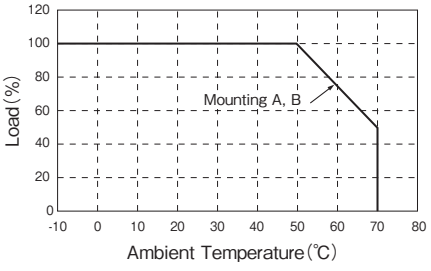
HWS300



HWS600



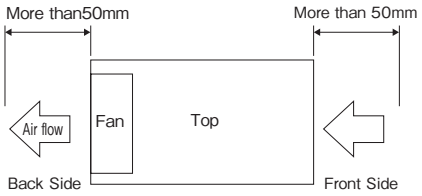
2 Output Derating



Ta (℃)	Load (%)	
	Mounting (A)	Mounting (B)
-10 to +50	100	
+70	50	

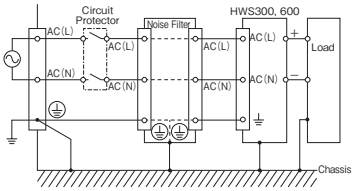
3 Mounting Method

(1) Forced air cooling type power supply.
This power supply has ventilating holes on the front and back side panels. Keep these two areas freely as much as possible.
(2) The maximum allowable penetration is 6mm.
Incomplete thread of mounting screw should not be penetrated.
(3) Recommended torque for mounting screw:
M4 screw: 1.27 N · m (13.0kgf · cm)



5. Wiring Method

(1) The output load line and input line shall be separated to improve noise sensitivity.
(2) The sensing lines shall be twisted and separated from the output lines for remote sensing.
(3) Use all lines as thick and short as possible to make lower impedance.
(4) Attaching a capacitor to the load terminals can eliminate noise.
(5) For safety and EMI considerations, connect ⏚ terminal to the mounting set ground terminal.
(6) Recommended torque for the terminal;
HWS600 Output terminal (M5 screw): 2.50 N · m (25.5kgf · cm)
HWS300 Input, Output terminal & HWS600 Input terminal (M4 screw): 1.27 N · m (13.0kgf · cm)



[The PHD connector manufacture method]
This product is using SPHD-001T-P0.5 or SPHD-002T-0.5 connector made from JAPAN SOLDERLESS TERMINAL MFG CO LTD.
Regarding to manufacture of a connector, it becomes the regulation as following.

a). Appricable Wire and Crimping tool
Wire size is AWG#26-AWG#22 and insulation outer dia is ϕ1.0-ϕ1.5mm.
Appreciable wire per barrel size is UL1007 (standard wire) and its equivalent standard wire can be used.
Regarding the AWG#22, use UL1061 or its equivalent standard wire, because wire insulation outer diameter of UL1061 is samll.
Crimping tool is as below.

Crimping tool	Crimping applicator	Dies
AP-K2 or AP-KS	MKS-LS-10 or MKS-L-10	SPHD-001-05/SPHD-002-05

b). Crimping Operation
The reference value of wire strip is 2.3mm. As wire strip length differs depending on type of wire and crimping method, decide the best wire strip length considering processing condition. When wire is stripped, do not damage or cut off wire conductores.
Table of crimp height

SPHD-001T-P0.5

Wire		Insulation O.D (mm)	Crimp height (mm)	
Type	Size		Conductor part	Insulation part
UL1007	AWG #26	1.3	0.60 - 0.70	1.7
UL1007	AWG #24	1.5	0.65 - 0.75	1.8
UL1061	AWG #22	1.4	0.70 - 0.80	1.8

SPHD-002T-P0.5

Wire		Insulation O.D (mm)	Crimp height (mm)	
Type	Size		Conductor part	Insulation part
UL1007	AWG #28	1.2	0.55 - 0.60	1.6
UL1007	AWG #26	1.3	0.60 - 0.65	1.7
UL1007	AWG #24	1.5	0.62 - 0.67	1.8

Note 1. Crimp height at wire barrel should be set to pre-determined dimensions.
Note 2. Adjust crimp height at wire insulation barrel to the extent that wire insulation is slightly pressed, and set it so that crimping is not excessivery.
Note 3. Crimping condition at wire insulation barrel is as below Fig.1.
Note 4. For AWG#28, #26, #24, use UL1007 type. For AWG #22, use UL1061 type.

Fig.1

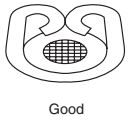
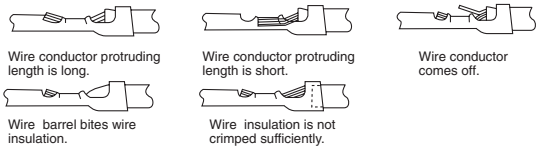


Fig.2: Examples of defective crimping



Check of crimping appearance visually for correct crimping as referring to above Fig.2
Check the tensile strength at crimped part when operation finishes.

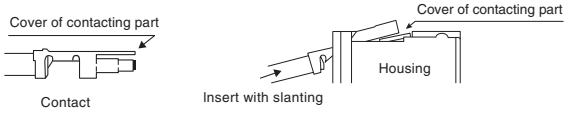
Table of tensile strength at crimped part.
SPHD-001T-P0.5

Wire size	Requirement N min.	Actual value N
UL1007 AWG#26	20	39.2 - 45.1
UL1007 AWG#24	30	68.6 - 74.5
UL1007 AWG#22	40	92.1 - 96.0

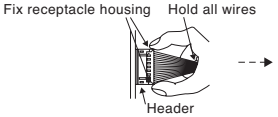
SPHD-002T-P0.5

Wire size	Requirement N min.	Actual value N
UL1007 AWG#28	15	27.0 - 34.3
UL1007 AWG#26	20	44.1 - 48.0
UL1007 AWG#24	30	66.6 - 71.5

c). Inserting contact into housing
Inserting crimped contact into housing
(1) Do not apply any pulling force to crimped part, and insert contact parallel to housing
(2) Insert contact into housing without stopping to innermost
(3) Check secure locking per each insertion by pulling wire softly in order to check that contact does not come off housing. Besides, check whether there is the backlash in the direction of insertion axis.
Defect example of slation insertion



d). Mating and Unmating Connector
(1) Inserting connector
Hold receptacle housing securely and insert into header straight against to header post until click sounds.
(2) Unmating connector
Hold all wires securely and fix receptacle housing by fingers so as to pry, and then, withdraw it on the mating axis.



e). Routing of Wire
Routing wire so as not to apply external force to connector except force to such an extent that wire slightly buckles, considering an enough length to route and fixing of wire.

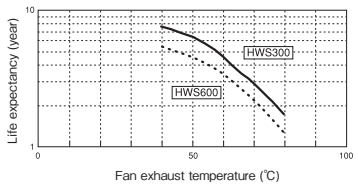
6. External Fuse Rating

Refer to the following fuse rating when selecting the external fuses that are to be used on input line. Surge current flows when line turns on. Use slow-blow or time-lag type fuse, not fast-blow fuse. Fuse rating is specified by in-rush current value at line turn-on. Do not select the fuse according to input current (RMS.) values under the actual load condition.

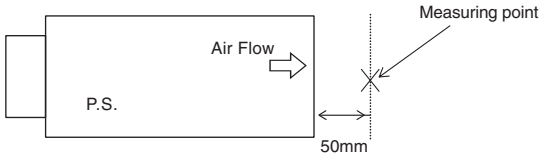
HWS300 : 10A
HWS600 : 15A

7. Fan life expectancy

The Fan-life has limitation. Therefore, periodic maintenance by exchanging the life-expired fan is required for the power supply. The following figure shows the life of fan.



Measurement point of fan exhaust temperature



The difference between the intake temperature and the exhaust temperature of the power supply at Io=100% :
HWS300: 4℃
HWS600: 8℃

8. Before concluding that the unit is at fault…

Before concluding that the unit is at fault, make the following checks.
(1) Check if the rated input voltage is connected.
(2) Check if the wiring of input and output is correct.
(3) Check if the I/O terminal connection is properly tighten by regulated torque.
(4) Check if the wire thickness is enough.
(5) Check if the output voltage control (V.adj) is properly adjusted. OVP might be trigged and output is shut down.
(6) If use function of the Remote ON/OFF control, check if the Remote ON/OFF control connector is not opened.
If in open condition, power supply will not output.
(7) Check if the built-in FAN is not stopped. Is FAN stopped by something irregulars or etc?
If FAN stops, the PF signal turn "High" level and OTP might be activated.
(8) Power supply has ventilating holes on the front and back panels. Check if there is any irregulars or dust, etc.
(9) Is the chassis of power supply hot abnormally? The output is shut down by OTP operation.
Please re-input after the unit to cool down sufficiently.
(10) Check if the output current and output wattage does not exceed specification.
(11) Audible noise can be heard when input voltage waveform is not sinusoidal.
(12) Audible noise can be heard during dynamic load operation.

9. Warranty

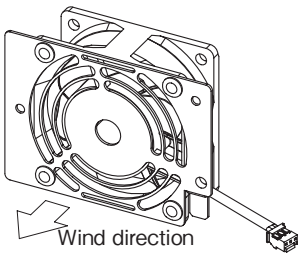
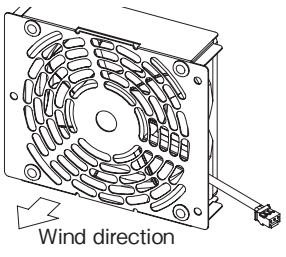
This product is warranted for a period of 5 years from the date of shipment. As for the breakdown under a normal use during free warrantee term, repair is at free of charge. However, the built-in FAN motor replacement is charged.

Please contact to our sales office for FAN replacement.
Please read the General Safety Instruction before using the products.

10. Option

❶ Fan unit for replacement

We have prepared an optional fan unit for replacement.

Name of fan unit for replacement	Applicable models	Appearance	Pin assignments	Price
300-FAN-01	HWS300 (of standard specifications)		Housing = PAP-03-V-S (J.S.T.) Contact = SPHD-001T-P0.5 or PSHD-002T-P0.5 (J.S.T.) Pin No. / Description: 1 Power supply; 2 Fan alarm; 3 GND Length of fan harness = 55 ± 10mm	Open
600-FAN-01	HWS600 (of standard specifications)		Housing = PAP-03-V-S (J.S.T.) Contact = SPHD-001T-P0.5 or PSHD-002T-P0.5 (J.S.T.) Pin No. / Description: 1 Power supply; 2 Fan alarm; 3 GND Length of fan harness = 70 ± 10mm	Open

Ask us for replacement of the fan. This will be a charged service. If you are replacing the fan by yourself, note the following.
*1. Be careful in handling the fan unit so as not to cause an impact by dropping it or hitting it, etc.
*2. Shut down the input before starting the replacement operation.
*3. Check that there are no loose parts in connectors or harness tucking, etc.
*4. Safety standards (UL, CE, etc.) are not applicable.

HWS 1000 Series Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read the following precautions thoroughly before using this power supply unit.
Pay attention to all warnings and cautions before using the unit. Incorrect usage could lead to an electric shock, damage to the unit or a fire hazard.

⚠ WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void your warranty.
- Do not touch the internal components; they may have high voltage or high temperature. You may get electric shock or burned.
- When the unit is operating, keep your hands and face away from it; an accident may injure you.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock.
  In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire, when using the unit under such condition.
- Do not operate these units at the condition of condensation. It may cause fire and electric shock.
- Power supplies with an output voltage of 48Vdc or less must be earthed in the end use equipment to maintain SELV. If the outputs are not earthed, they must be considered hazardous and must not be made user accessible.
- Power supplies with an output voltage of 60Vdc are considered to be non-SELV. As a result of this, the output must be guarded or a deflector fitted during installation to avoid a SERVICE ENGINEER making inadvertent contact with the output terminals, or dropping a tool onto them. The output of this product must not be connected to a SELV circuit.

Note : CE MARKING

- CE Marking when applied to a product covered by this handbook indicates compliance with the low voltage directive (2006/95/EC) in that it complies with EN60950-1.

⚠ CAUTION

- This power supply is primarily designed and manufactured to use and enclose in other equipment.
- This power supply unit has a built-in fan for air-cooling. Do not block air intake and exhaust. It might cause fire.
- Input voltage, output current, output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.
- The unit might be broken down by accident or unexpected situation. For application equipment, which requires very high reliability (nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not make an improper wiring to input and output terminals. It may cause damage.
- Do not use in environment such as strong electromagnetic field, erosive gas etc, or any environment where conductive foreign substance may enter.
- Do not operate and store this unit at the condition of condensation. In such case, waterproof treatment is necessary.
- Do not operate this unit after it falls down.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240VA or more), prevention from direct contact with voltage output is highly necessary. While installing or servicing this power supply unit, avoid dropping tools by mistake or direct contact with voltage output. This might cause an electrical shock.
  While repairing this power supply unit, the AC input power must be switch off and the I/O terminal voltage should be less than the safety level.

CAUTION of IEC/EN/UL60601-1 for HWS1000/ME

⚠ CAUTION

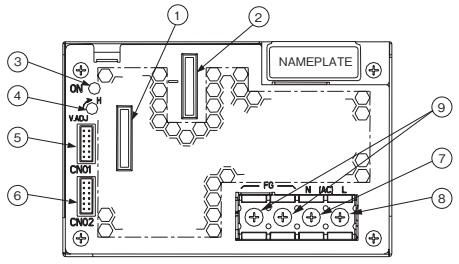
- These products are designed for continuous operation within an overall enclosure, and must be mounted such that access to the mains terminals is restricted. See Clause 16, IEC/EN/UL60601-1.
- These products are NOT suitable for use in the presence of flammable anaesthetic mixtures with air or with oxygen or with nitrous oxide.
- Connect only apparatus complying with IEC/EN/UL60601-1 to the signal ports.
- Except for permanently installed equipment as defined in Clause 57.6 of IEC/EN/UL60601-1 the overall equipment in which these products are installed must have double pole fusing on the input mains supply. The products themselves have single pole fusing in the live line.
- These products provide basic insulation only between mains and output, with reference to IEC/EN/UL60601-1.Sure to add supplemental insulation to input or output in the equipment.
- Reference should be made to local regulations concerning the disposal of these products at the end of their useful life.
- The maximum normal leakage current of this product is 500 microamperes for IEC/EN/UL60601-1. When using it as a patient care equipment, all outer surfaces of the equipment shall be constructed of nonconductive material. See Clause 19.5DV.2 of UL60601-1.
- These products have not been assessed to IEC/EN60601-1-2 (EMC) but EMC test data is available from TDK-Lambda.

1. Terminal Explanation

Please pay extra attention to the wiring. Incorrect connection will damage the power supply.

- When connecting input and output wiring, input AC-Line should be off.
- Input wiring and output wiring shall be separated, otherwise noise susceptibility of power supply unit will be weak.
- The protective earth (PE) must be connected to the instrument chassis and the chassis of this power supply unit.
- Remote sensing lines shall be twisted or use the shielded wire.
- Remote ON/OFF control lines shall be twisted or use the shielded wire.

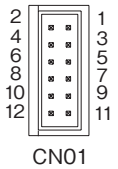
1 Front Panel Explanation



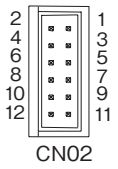
① +: + Output terminal
② −: − Output terminal
③ ON: Output (Power On) indication green LED (The indicator turns on when the power supply output is in normal operating condition.)
④ V.ADJ: Output voltage adjust trimmer (The output voltage rises when trimmer is turned clockwise.)
⑤ CN01: } Remote sensing, ON/OFF control signal, Current balance signal,
⑥ CN02: } Output voltage external control signal and Power fail signal output connector.
⑦ N: AC input terminal N : Neutral line
⑧ L: AC input terminal L : Live Line (Fuse in line)
⑨ FG: Function Ground terminal (Frame ground)

2 CN01, CN02 Connector pin configuration and function

CN01, CN02 pin configuration and function are the same.
They are connected to each other in this power supply unit.
When the pin of CN01 side is shorted the same function pins of CN02 side are shorted.
Please note that the function cannot be separately set with CN01 and CN02.



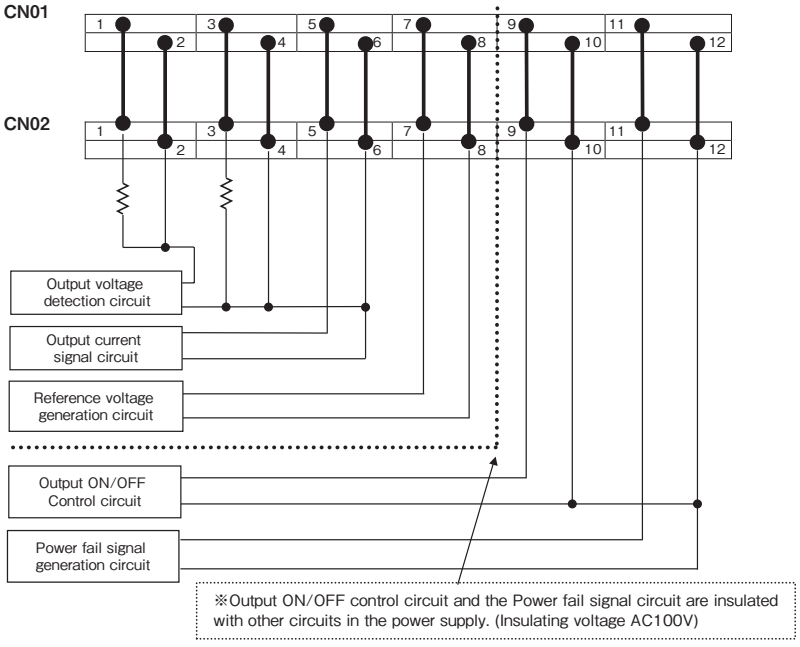
CN01



CN02

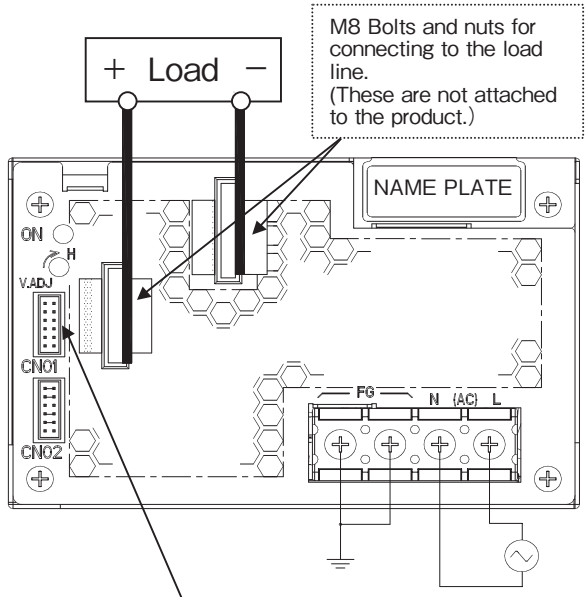
Pin No.	Configuration	Function
1	+V	Connected to +Output terminal in this power supply unit. (+V terminal can not supply load current.)
2	+S	Remote sensing terminal for +Output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to +V terminal when remote sensing function is unnecessary.)
3	-V	Connected to -Output terminal in this power supply unit. (-V terminal can not supply load current.)
4	-S	Remote sensing terminal for -Output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to -V terminal when remote sensing function is unnecessary.)
5	PC	Current balance terminal (For output current balancing in parallel operation.)
6	COM	Ground for PC and PV signal.
7	PV	Output voltage external control terminal (For power supply output voltage control with an external voltage. Connect it with the terminal REF when PV function is unnecessary.)
8	REF	Reference voltage terminal for Output voltage control (REF and PV are connected when shipping.)
9	CNT	Remote ON/OFF control terminal (When the CNT is pulled to TTL low, the power supply turns on.)
10	TOG	Ground for CNT and PF signal.
11	PF	Power fail signal output terminal. (As the output voltage drops, FAN stops and AC input voltage down, open collector output, "Power Fail" signal will output "High".)
12	TOG	Ground for CNT and PF signal.

CN01, CN02 are connected in this power supply unit as follows.



3 Basic Connection (Local sensing)

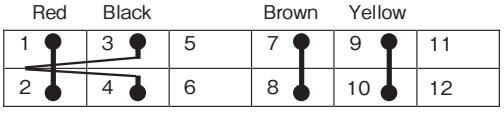
① Connect "+S" terminal to "+V" terminal and "-S" terminal to "-V" terminal with sensing wires.
② Connect "CNT" terminal to "TOG" terminal with wire.
③ Connect "PV" terminal to "REF" terminal with wire.
※ Please use attachment connector for each connection.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.



Connector : (JST) S12B-PHDSS

Attached connector when shipping
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
1—2, 3—4, 7—8, 9—10 are shorted.

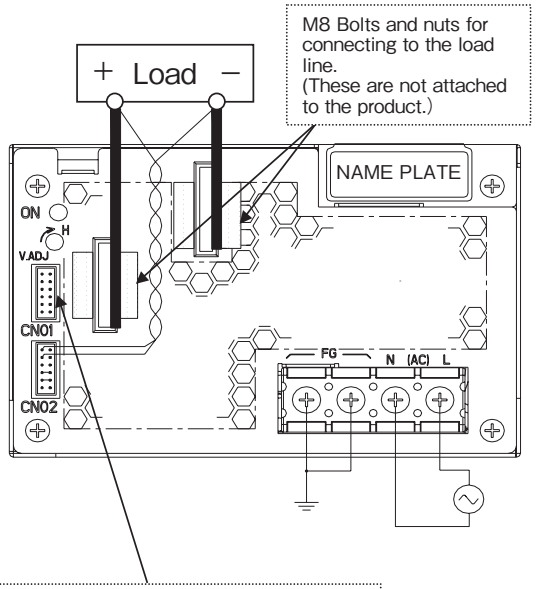
Attached connector when shipping



Twist wire

4 Remote sensing required

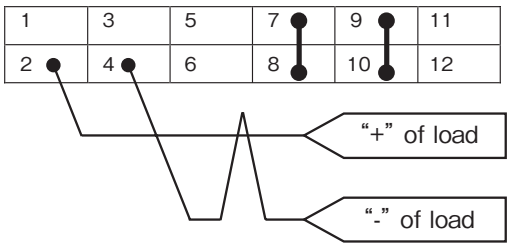
① Connect "+S" terminal to "+" terminal of load with sensing wire.
② Connect "-S" terminal to "-" terminal of load with sensing wires.
③ Connect "CNT" terminal to "TOG" terminal with wire.
④ Connect "PV" terminal to "REF" terminal with wire.
※ The accuracy of the output voltage will deteriorate when the sensing terminals are opened.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.



Connector : (JST) S12B-PHDSS

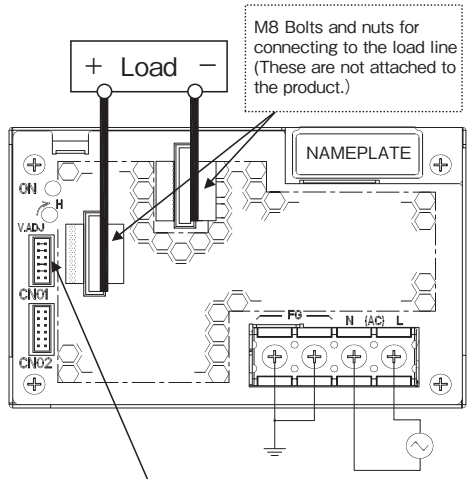
Remove standard attached connector, and use the harness made by the customer.
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
2—"+" of load, 4—"-" of load should be connected.
7—8, 9—10 : should be shorted
*Please use wire for contact and crimping tool specified by maker.

Connecting circuit with CN01 or CN02 connector



5 Remote ON/OFF control required

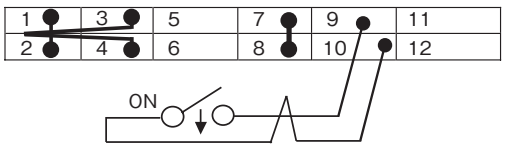
① Remove standard attached connector, and use the harness made by the customer and connect external signal to between CNT and TOG terminal.
② "TOG" terminal is ground for "CNT" terminal.
In case this function is not used, please short between CNT and TOG terminal.



Connector : (JST) S12B-PHDSS

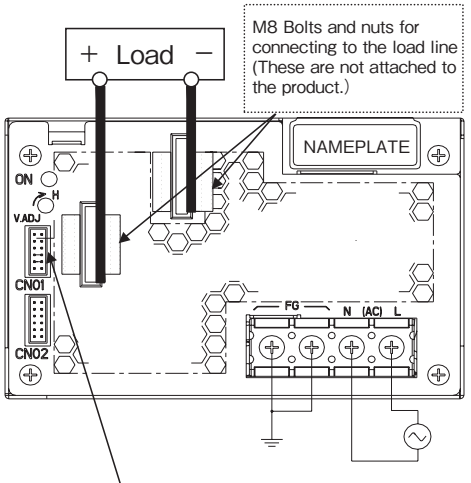
Remove standard attached connector, and use the harness made by the customer.
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
1−2, 3−4, 7−8 : should be shorted
9 : CNT
Should be connected to ON/OFF control signal.
10 : TOG
Should be connected to Signal Ground.
＊Please use wire for contact and crimping tool specified by maker.

Connecting circuit with CN01 or CN02 connector



6 PF signal output required

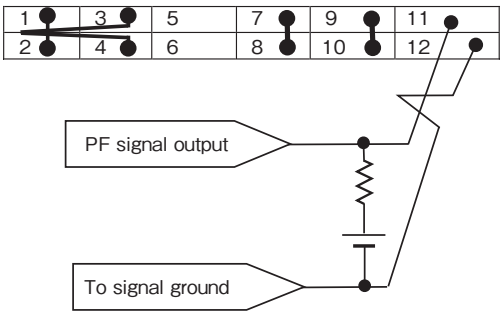
① PF signal is an open collector output, therefore PF signal outputs is shown in circuit below.
② "TOG" terminal is ground for "PF" terminal.



Connector : (JST) S12B-PHDSS

Remove standard attached connector, and use the harness made by the customer.
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
1−2, 3−4, 7−8, 9−10 : should be shorted.
11 : PF
Should be connected to PF signal output
12 : TOG
Should be connected to Signal Ground.
＊Please use wire for contact and crimping tool specified by maker.

Connecting circuit with CN01 or CN02 connector



2. Functions and Precautions

1 Input Voltage Range

Input voltage range is single phase 85−265VAC (47−63Hz). Input voltage, which is out of specification, may cause unit damage. Rated input voltage range fix during safety standard application is from100V to 240VAC (50/60Hz).
While applying input voltage from 85VAC to 90VAC, output load current derating is required.

2 Output Voltage Range

Output voltage is set to the rated value at shipping. V.ADJ trimmer on the front panel side is use to adjust the output voltage within the range specified. Output voltage trimming range is within -20%−+20% of the rated output voltage (48V, 60V model: -20%−+10%). Turn the trimmer clockwise to increase output voltage. Take note when the output voltage is increased excessively over voltage protection (OVP) function may trigger and output voltage will shut down.
Use the output power of the power supply below the rated output power value when you raise the output voltage.

3 Over Voltage Protection (OVP)

The OVP function (Inverter shut down method, manual reset type) is provided. OVP function operates within 125-145% of the rated DC output voltage value (3-7V model: 125-140%, 36V model: 125-138%, 48V, 60V model: 115-125%), and the output will be shut down when OVP function triggers. When OVP function operates, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal shall be input for recovery of the output. OVP value is fixed and can not be adjusted.

4 Over Current Protection (OCP)

The OCP function (Constant current limiting, Time delay shutdown type) is provided. OCP function operates when the output current exceeds 105% of maximum DC output current specification and the over current or short circuit condition continues 5-second or more, the output will be shut down. When the OCP is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output. The OCP setting is fixed and not to be adjusted externally.

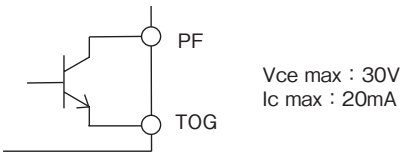
5 Over Temperature Protection (OTP)

Over temperature protection function (manual reset type) is provided. When ambient or internal temperature rises abnormally, OTP will shut down the output. When OTP is triggered, input power is cut off and allow sufficient cooling to reset the OTP function. Then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

6 Low Output Detection Circuit (PF)

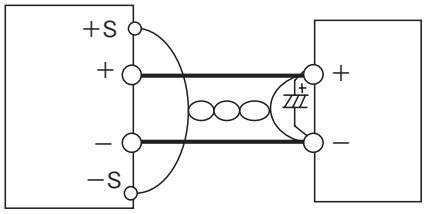
Low output voltage detection circuit is provided. Power Fail signal (PF signal) will output when output voltage decrease by either the drop or brown out of the input voltage or OCP, OVP and OTP function operation. PF signal will turn "High" level to indicate the abnormal status of the power supply when the output voltage decrease to 80% of the output voltage setting value. However, there is a possibility that PF signal may not output during parallel operation. The PF signal circuit is insulated from the power supply input and output circuit and it is an open collector. TOG terminal is ground for PF terminal.

When the Built-in Fan Motor of this power supply unit stops, PF signal will turn to "H" and the output power will shut down. The Built-in Fan Motor is a component with lifetime. We recommend a periodic replacement. Please contact our sales office. Replacement is at customer's expenses.



7 Remote Sensing (+S, -S terminal)

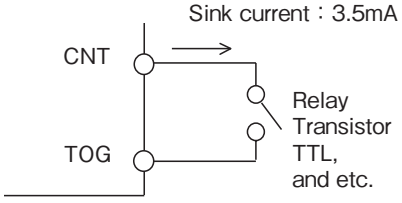
Remote sensing function is provided to compensate for voltage drop across the wiring from the power supply output terminals to the load input terminals. Connect "+S" terminal to "+" terminal of the load and "-S" terminal to "-" terminal of the load with sensing wires. The total line voltage drop (+ side line and - side line) shall be less than 0.3V. In case that sensing line is too long, it is necessary to put an electrolytic capacitor across the load terminals.
Please take note that the electrolytic capacitor has generation of heat etc. done by the ripple current depending on connected load. Therefore, the electrolytic capacitor must have a ripple current allowance higher than the output ripple current. If CN01 (or CN02) is in use, terminal +S, -S for CN02 (or CN01) must be in open condition.



When the function of remote sensing is not in used, connect +S terminal to +V terminal, and -S terminal to -V terminal by the attachment connector.
If remote sensing terminals are opened, the stability and the accuracy of the output deteriorate. Therefore, terminal +S, -S must be connected.

8 Remote ON/OFF Control

Remote ON/OFF control is provided. Output can be remotely switch ON and OFF by using CNT terminal and TOG terminal even though input is connected. The output is turned to ON when TOG and CNT terminals are shorted and output is turned to OFF when these terminals are opened. When the function is not used, connect TOG and CNT terminals with short piece. The standards for this function are as follows. "TOG" terminal is ground for "CNT" terminal.



The Mode of control

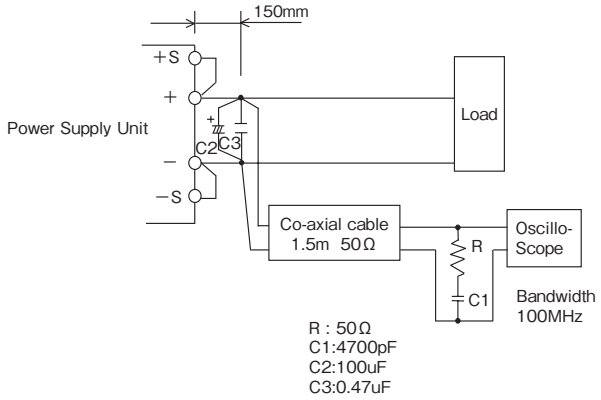
CNT Level for TOG Terminal	Output	Built-in Fan Motor
Short or L(0−0.8V)	ON	Rotate
Open or H(2.4−12V)	OFF	Stop

1) TTL compatible. The maximum input voltage to CNT terminal is 12V, and the maximum allowable reverse voltage is -1V. The sink current of CNT terminal is 3.5mA.
2) Output ON/OFF control can be enable by a switch, relay or a transistor ON/OFF. When CNT terminal−TOG terminal is shorted power supply is turn ON, and when CNT terminal−TOG terminal is opened power supply is turn OFF.
3) Remote ON/OFF control circuit is isolated from the input and output circuit of power supply.
It is possible to use it regardless of the positive and negative of the power supply output.

Please be aware that if CNT terminal and TOG terminal is short and input voltage is gradually increase, this will trigger the low output voltage detector protection circuit and will result to output voltage shut down.
When the low output voltage detector protection circuit is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

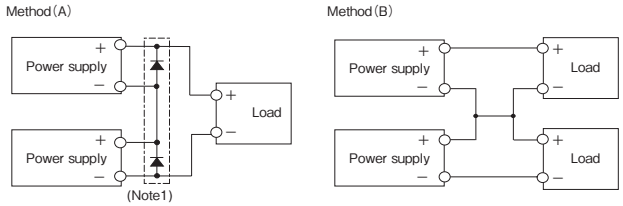
9 Output Ripple & Noise

Maximum ripple & noise value in specifications is measured according to measurement circuit specified by JEITA-RC9131A. When Load lines are longer, ripple & noise becomes larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal. The output ripple & noise cannot be measured accurately if the probe ground lead of oscilloscope is too long.



10 Series Operation

For series operation, either method (A) or (B) is possible.
There might be a step in the rise waveform during series operation.



(Note1) Please connect a diode for by-pass when using method (A) of the series operation.
Please use the diode with rated forward current is equal or more than load current and that the rated maximum reverse voltage is higher than output voltage for each power supply.

11 Parallel Operation

Current balancing function is provided. Either of operations mode (A) or (B) is possible.

(A) To Increase the Output Current

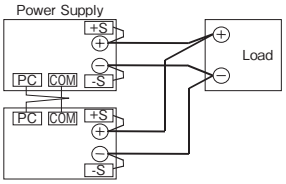
Current balancing function activates by connecting PC-to-PC terminal and COM-to-COM terminal, and output current of each power supply is equivalently supplied to load. Wires to PC terminals shall be as short as possible, same length and twisted.
There is a possibility that output could be unstable caused by external noise. For this case, disconnect COM terminal and connect -S terminal from parallel power supply to a single point on the load. Please refer connection Method (A)-2.

1) Adjust the output voltage of each power supply to be same value within 1% or 100mV, whichever is smaller.
2) Use same length and type of wires for all load lines.
3) Maximum value of output current in parallel is up to 80% of all paralleled models. The purpose of the current balancing function is the static power-up. Therefore the output voltage might decrease according to the condition of dynamic load. There might be a step in the rise waveform during parallel operation.
4) Up to 5 units can be connected in parallel.

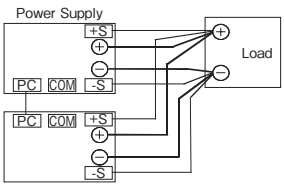
(B) To Use as a Backup Power Supply

1) Set power supply output voltage higher by the forward voltage drop of diode.
2) Adjust the output voltage of each power supply to be same value.
3) Use within the specifications for output voltage and output power.

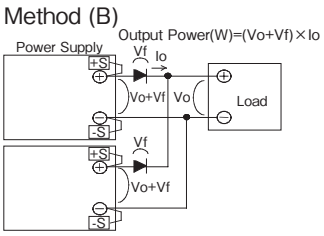
Method (A)-1



Method (A)-2

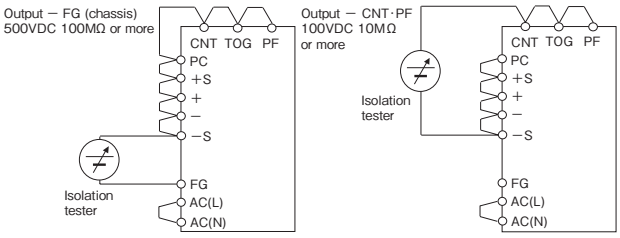


Method (B)



12 Isolation Test

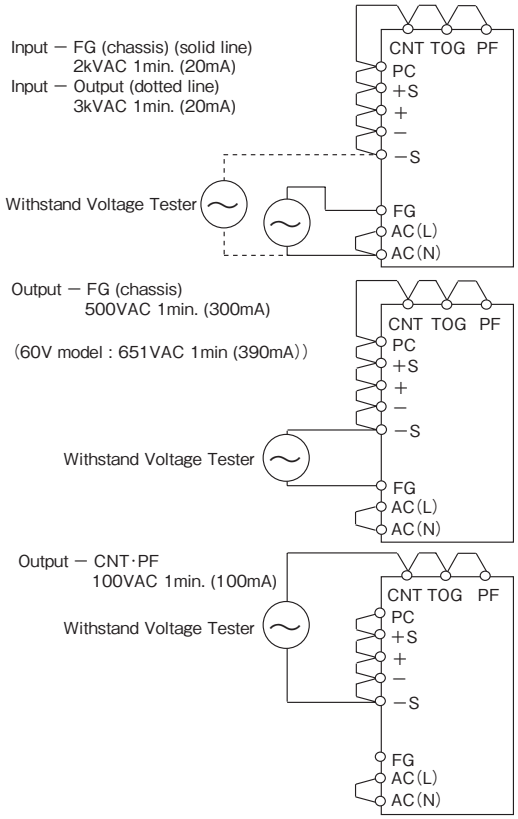
Isolation resistance between output and FG (chassis) shall be more than 100MΩ at 500VDC and between output and CNT·PF shall be more than 10MΩ at 100VDC. For safety operation, voltage setting of DC isolation tester must be done before the test. Ensure that it is fully discharged after the test.



13 Withstand Voltage

This series is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and FG (chassis), 500VAC (60V model : 651VAC) between output and FG (chassis), and 100VAC between output and CNT·PF terminal each for 1 minute. When testing withstand voltage, set current limit of withstand voltage test equipment at 20mA.
(Output-FG (chassis) : 300mA (60V model : 390mA), Out

put- CNT·PF : 100mA).
The applied voltage must be gradually increased from zero to testing value and then gradually decreased for shut down. When timer is used, the power supply may be damaged by high impulse voltage at timer switch on and off. Connect input and output as follows. If output is left open during test, output voltage might appear momentarily.
This product have monolithic ceramic capacitor in secondary circuit to frame ground.
Some of the withstand voltage tester may generate high voltage at the matching with monolithic ceramic capacitor and may cause the unit damage.
So, please check the waveform of test voltage.

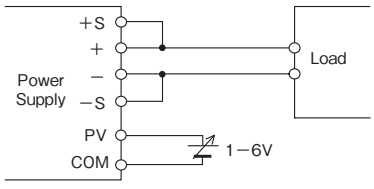


14 Output Voltage External Control (PV)

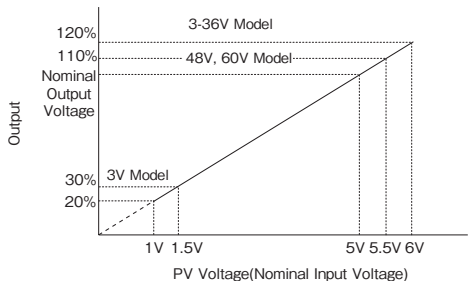
(A) Control by External Voltage

Output voltage external control function is provided. Output voltage can be varied by applying an external voltage (1—6V) to "PV" terminal and "COM" terminal. Note if an external voltage is not applied, there will be no output. Please consider the following characteristics below when operating the unit.

Connection Method



Output Voltage Linearity

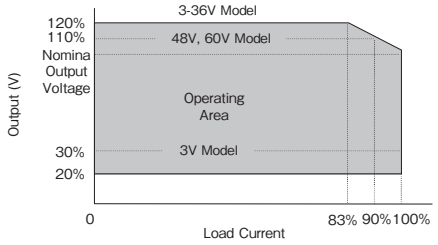


Note: Only as for the model of 3V output, the output voltage is used from 30% to 120% at the PV voltage is from 1.5V to 6.0V

Note: Only as for the model of 5-36V output, the output voltage is used from 20% to 120% at the PV voltage is from 1V to 6.0V

Note: Only as for the model of 48V, 60V output, the output voltage is used from 20% to 110% at the PV voltage is from 1V to 5.5V.

Output Voltage Derating

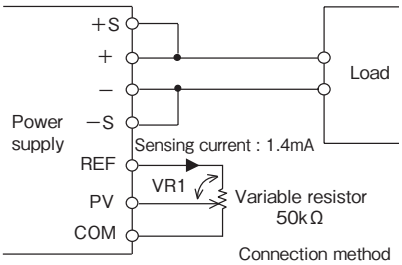


Note: Only as for the type of 48V, 60V output, the maximum output voltage is used up to 110% at 90% load current.

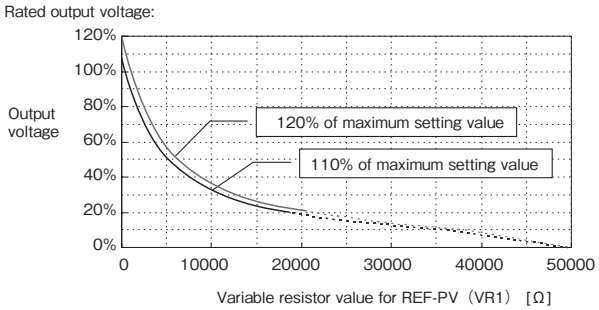
(B) Control by External Variable Resistor

"PV" terminal and "COM" terminal usage is the same as explained in section 「"control by external voltage"」. But in this method voltage for control is supplied through REF terminal. Variable resistor is connected between REF terminal and COM terminal and the middle point of variable resistor is connected to PV terminal. Please use the output voltage within 20% - 120% of rated output voltage value (3V model : 30% - 120%, 48V, 60V model : 20% - 110%). Wires for control lines must be twisted wire or shielded wire. In addition, maximum variable voltage when control by external variable resistor is rated output voltage (100%). When output voltage must be externally control to 120% of rated output voltage (110% for 48V, 60V model), please follow the following procedure.

(1) PV terminal and REF terminal is short by using standard connector supplied.
(2) Set the power supply output voltage to maximum value of the output voltage variable range mentioned in specification standard by adjusting V.ADJ volume at the front panel.
(3) Remove standard connector after input is cut off.
(4) Connect external variable resistor (50kΩ) between REF terminal and COM terminal. Then connect middle point of external variable resistor to PV terminal. (sensing current is 1.4mA)



When output voltage is over rated value, please make sure that maximum output power is below rated value. Moreover, when output voltage is below rated value, please make sure that maximum output current is below rated value.
Please consider the following characteristic during usage.



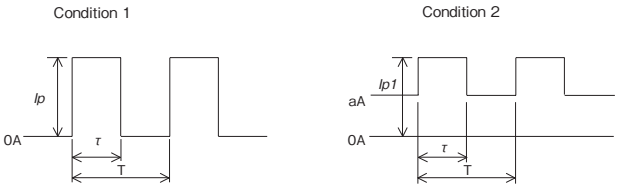
* Adjustable output voltage within 20%(3Vmodel : 30%) of output (less than 1V of PV voltage) is proportional to PV voltage and has a linear characteristic. However, for output voltage within 10% of output (about less than 0.5V of PV voltage), output will go into intermittent mode and ripple voltage becomes large, also irregular sound is release from the power supply. However, it is not damage. There will also be cases of the power supply shutting down triggered by under voltage lock out protection function. With output shutting down, low output detection function (PF) triggers the PF signal and set it to "H", and also output LED is switch off. Under voltage lock out protection mode, switch off input for a few minutes and then switch on input again for recovery. Recovery from under voltage lock out is also possible by turning remote ON/OFF control signal OFF and ON. Under voltage detection value uses an automatic tracking mode, which follows the output voltage and constantly correspond to the 70%-80% of output voltage with a protection function mode. Base on the explanation above, we will kindly exclude the usage of adjustable output voltage within 20% of the output voltage from the product warranty. For application that requires variable output voltage within 20% of output voltage, please kindly consider the above contents prior to operation. For application that requires output voltage below 20%, due to different type of application for the user's system, there might be a situation (behavior) different from the one mentioned above. Therefore please check with the user system.

15 Output Peak Current

For model with output peak current, please meet the following condition.
Reduce peak current value according to output derating as section 4-1.
The output is shut down by protection circuit when rated current and continuous peak output time (τ) exceeds rated value during usage.
When protection circuit is activated, input is temporarily cut off for a few minutes and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

Input voltage range	: AC180V - 265V
Continuous Peak output time (τ)	: Within 10 seconds
Peak output current (Ip)	: Within the rated peak output current
Duty	: up to 35%

$$\text{Duty} = \frac{\tau}{T} \times 100(\%)$$



$$\sqrt{Ip^2 \times \frac{\tau}{T}} \leq Irms\ max \qquad \sqrt{Ip1^2 \times \frac{\tau}{T} + a^2 \times (1 - \frac{\tau}{T})} \leq Irms\ max$$

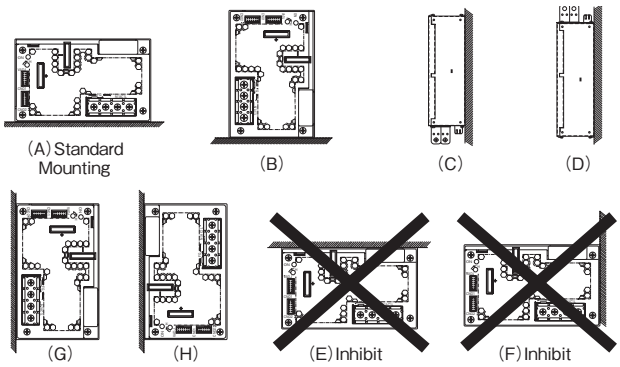
Ip, Ip1 : Peak output current (A)
Irms : Effective current (A)
τ : Peak current pulse width (sec)
T : Cycle (sec)

Model	Irms max
HWS1000-7	94.6A
HWS1000-12	59.1A
HWS1000-15	47.3A
HWS1000-24	34.6A
HWS1000-36	23.0A
HWS1000-48	17.2A
HWS1000-60	13.8A

3. Mounting Directions

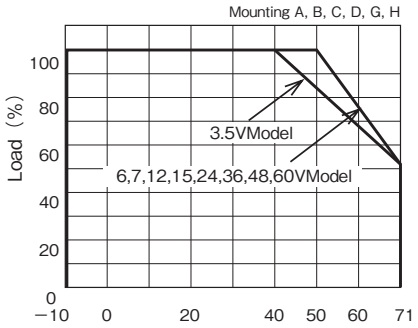
1 Output Derating

Mounting directions are as follows.
Standard mounting method is (A). Methods (B), (C), (D), (G) and (H) are also possible.
Mounting methods besides (A), (B), (C), (D), (G) and (H) (example : (E) and (F)) are inhibited.



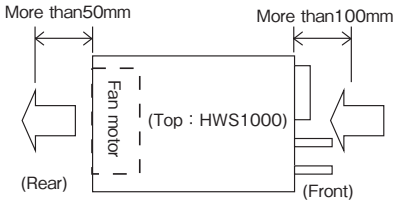
HWS1000 Output Derating

3, 5V Ta(℃)	6-60V Ta(℃)	LOAD(%)					
		A	B	C	D	G	H
−10 - +35	−10 - +35	100					
40	50	100					
71	71	50					



2 Mounting Method Caution

(1) This Power supply unit is a forced air-cooling system with a built-in fan.
(2) This power supply has ventilating holes on the front and back panels.
Keep these areas freely more than 100mm from front side and more than 50mm from rear side.
(3) Please note that ventilation will be worsened in a dusty environment.
(4) Built-in fan is limited life part, which require periodic replacement. (Replacement will be charged).
(5) The ambient temperature of this power supply is less than 50mm from the center of a front side.
(6) The maximum allowable penetration of mounting screw is 6mm.
(7) Recommended torque for mounting screw (M4) is 1.27N·m.

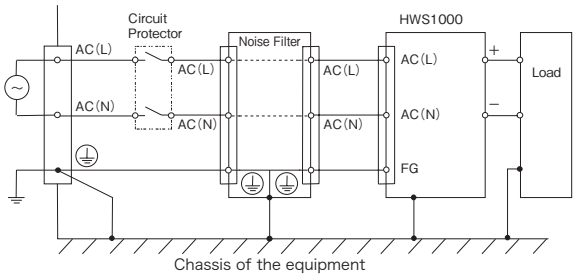


4. Wiring Method

(1) The output load line and input line shall be separated and twisted to improve noise sensitivity.
(2) The sensing lines shall be twisted or shield wire and separated from the output lines.
(3) Use all lines as thick and short as possible to make lower impedance. Wires are to be twisted or use shield wire to improve noise sensitivity.
(4) Attaching a capacitor to the load terminals can eliminate noise.
(5) FG terminal of this power supply is functional earthing. For safety purposes, connect protective earthing terminal to the mounting set ground terminal.
(6) Recommended torque for the terminal piece:

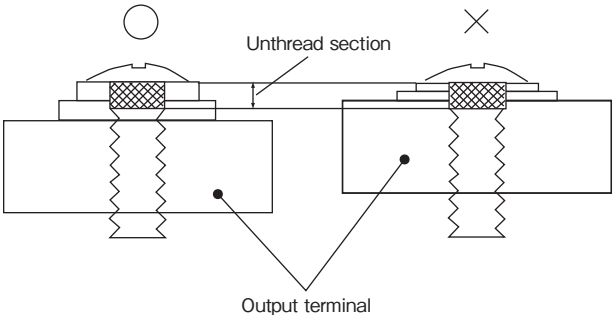
Input terminal (M4 screw):	1.27 N·m
Output terminal (M8 Bolt & Nut):	10.8N·m

(7) Recommended wiring



Recommended circuit protector: AC250V20A
Recommended noise filter: RSEN-2020 (TDK-Lambda)

(8) M4 screw for output terminal might damage the terminal's inner thread. This is mainly cause by the M4 screw's unthread section. Therefore, please select a washer, spring washer, etc. to avoid unthread screw section from penetrating into output terminal inner section.



5. External Fuse Rating

Refer to the following fuse rating when selecting the external fuses for input line. Surge current flows when line turns on. Use slow-blow fuse or time-lug fuse. Do not use fast-blow fuse. Fuse rating is specified by in-rush current value at line turn-on. Do not select the fuse according to input current (rms.) values under the actual load condition.

HWS1000：20A

6. Troubleshooting

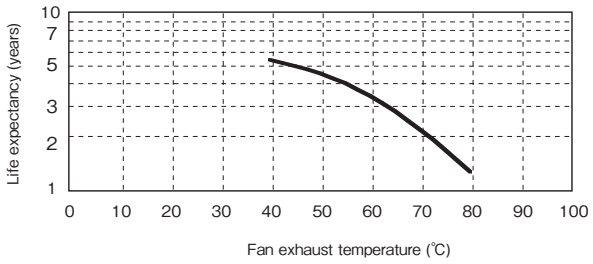
Before concluding that the unit is at fault, make the following checks.

(1) Check if the rated input voltage is apply.
(2) Check if the wiring of input and output is correct.
(3) Check if the I/O terminal connection is properly tighten by a regulated tightening torque.
(4) Check if the wire material is not too thin.
(5) Check if the output voltage control (V.ADJ) is properly adjusted. OVP might be trigged and output is cut off.
(6) Check if the wiring of "+S" and "-S" terminal is correct. If in open condition, the stability and the accuracy of the output deteriorate.
(7) If use function of the remote ON/OFF control, check if the remote ON/OFF control connector is not opened.
If in open condition, output is cut off.
(8) Check if the built-in fan is not stopped. Is fan stopped by something irregulars or dust, etc.
If fan stops, the PF signal is turn on.
Moreover, the output is intercepted with the protection circuit if fan stops.
Fans are the limited life parts.
(9) This power supply has ventilating holes on the front and back panels. Check if there is any irregulars or dust, etc.
(10) Is the main body of the power supply abnormally hot? Please turn on the input again after allowing the unit to cool down sufficiently. The output shut down by over temperature protection function.
(11) Check if the output current and output power is not applied over specification.
(12) Check if the input voltage wave is sinusoidal. If this power supply unit is connected to a UPS, input voltage wave might not be sinusoidal. An audible noise is emmited from the power supply unit.
(13) Audible noise can be heard during Dynamic-Load operation.

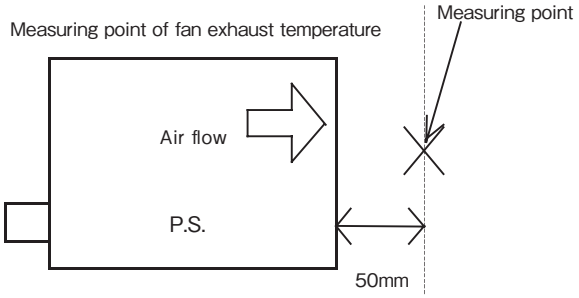
7. Warranty

This product is warranted for a period of 5 years from the date of shipment. As for the breakdown under a normal use during free warrantee term, repair is at free of charge. However, the Built-in Fan Motor replacement is for a fee. Please contact your nearest sales office for replacement.

The Fan-life has limitation. Therefore, periodic maintenance by replacing the life-expired fan is required.
The following figure shows the life of fan.



＊Life expectancy
Fan exhaust temperature 45℃ 45,000 hours
Fan exhaust temperature 80℃ 11,000 hours

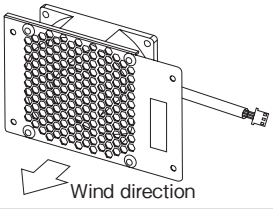


Please read the General Safety Instruction before using the products.

8. Option

1 Fan unit for replacement

We have prepared an optional fan unit for replacement.

Name of fan unit for replacement	Applicable models	Appearance	Pin assignments	Price
1500-FAN-01	HWS1000 HWS1500 HWS1800T (of standard specifications)		Housing = XHP-3 (J.S.T.) Contact = SXH-001T-P0.6 (J.S.T.)	Open

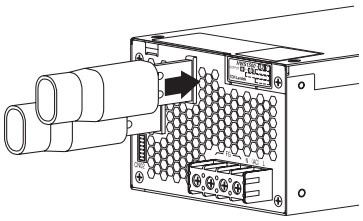
Pin No.	Description
1	Power supply
2	Fan alarm
3	GND

Length of fan harness = 65 ± 10mm

Ask us for replacement of the fan. This will be a charged service. If you are replacing the fan by yourself, note the following.
*1. Be careful in handling the fan unit so as not to cause an impact by dropping it or hitting it, etc.
*2. Shut down the input before starting the replacement operation.
*3. Check that there are no loose parts in connectors or harness tucking, etc.
*4. Safety standards (UL, CE, etc.) are not applicable.

2 Insulation tube for HWS1000

The following insulation tube can becuse for output terminal.
・TCV-2001 (shinagawa shoko)
Please confirm shape and size from manufacturer catalog.



Example of use for insulation tube

HWS 1500 Series Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read the following precautions thoroughly before using this power supply unit.
Pay attention to all warnings and cautions before using the unit. Incorrect usage could lead to an electric shock, damage to the unit or a fire hazard.

⚠ WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void your warranty.
- Do not touch the internal components; they may have high voltage or high temperature. You may get electric shock or burned.
- When the unit is operating, keep your hands and face away from it; an accident may injure you.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock.
  In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire, when using the unit under such condition.
- Do not operate these units at the condition of condensation. It may cause fire and electric shock.
- Power supplies with an output voltage of 48Vdc or less must be earthed in the end use equipment to maintain SELV. If the outputs are not earthed, they must be considered hazardous and must not be made user accessible.
- Power supplies with an output voltage of 60Vdc are considered to be non-SELV. As a result of this, the output must be guarded or a deflector fitted during installation to avoid a SERVICE ENGINEER making inadvertent contact with the output terminals, or dropping a tool onto them. The output of this product must not be connected to a SELV circuit.

Note : CE MARKING

- CE Marking when applied to a product covered by this handbook indicates compliance with the low voltage directive (2006/95/EC) in that it complies with EN60950-1.

⚠ CAUTION

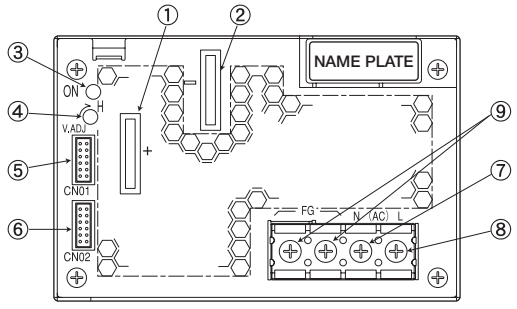
- This power supply is primarily designed and manufactured to use and enclose in other equipment.
- This power supply unit has a built-in fan for air-cooling. Do not block air intake and exhaust. It might cause fire.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.
- The unit might be broken down by accident or unexpected situation. For application equipment, which requires very high reliability (nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not make an improper wiring to input and output terminals. It may cause damage.
- Do not use in environment such as strong electromagnetic field, erosive gas etc, or any environment where conductive foreign substance may enter.
- Do not operate and store this unit at the condition of condensation. In such case, waterproof treatment is necessary.
- Do not operate this unit after it falls down.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240VA or more), prevention from direct contact with voltage output is highly necessary. While installing or servicing this power supply unit, avoid dropping tools by mistake or direct contact with voltage output. This might cause an electric shock.
  While repairing this power supply unit, the AC input power must be switch off and the I/O terminal voltage should be less than the safety level.

1. Terminal Explanation

Please pay extra attention to the wiring. Incorrect connection will damage the power supply.

- When connecting input and output wiring, input AC-Line should be off.
- Input wiring and output wiring shall be separated, otherwise noise susceptibility of power supply unit will be weak.
- The protective earth (PE) must be connected to the instrument chassis and the chassis of this power supply unit.
- Remote sensing lines shall be twisted or use the shielded wire.
- Remote ON/OFF control lines shall be twisted or use the shielded wire.

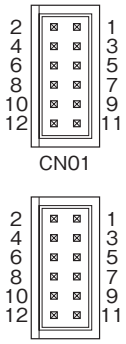
1 Front Panel Explanation



① ＋ : ＋ Output terminal
② － : － Output terminal
③ ON : Output (Power On) indication green LED
(The indicator turns on when the power supply output is in normal operating condition.)
④ V.ADJ : Output voltage adjust trimmer (The output voltage rises when trimmer is turned clockwise.)
⑤ CN01 : ⑥ CN02 : } Remote sensing, ON/OFF control signal, Current balance signal, Output voltage external control signal and Power fail signal output connector.
⑦ N : AC input terminal N : Neutral line
⑧ L : AC input terminal L : Live Line (Fuse in line)
⑨ FG : Function Ground terminal (Frame ground)

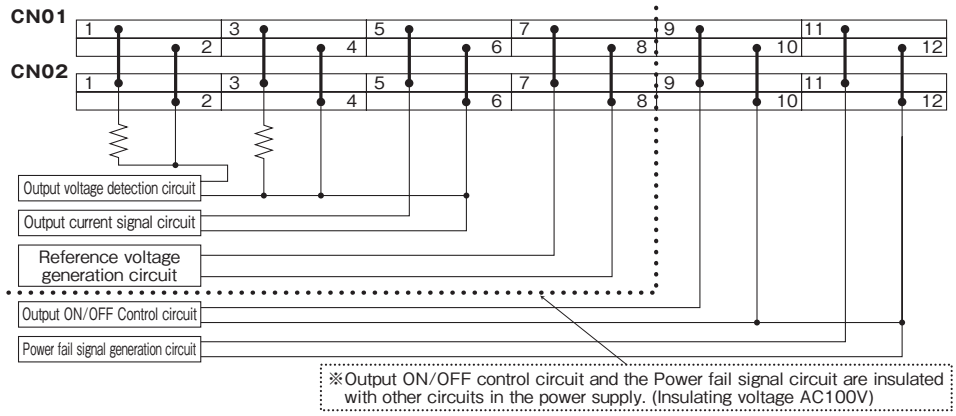
2 CN01, CN02 Connector pin configuration and Function

CN01, CN02 pin configuration and function are the same.
They are connected to each other in this power supply unit.
When the pin of CN01 side is shorted the same function pins of CN02 side are shorted.
Please note that the function cannot be separately set with CN01 and CN02.



Pin No.	Configuration	Function
1	+ V	Connected to + Output terminal in this Power supply unit. (+V terminal can not supply load current.)
2	+ S	Remote sensing terminal for + output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to +V terminal when remote sensing function is unnecessary)
3	− V	Connected to − Output terminal in this Power supply unit. (-V terminal can not supply load current)
4	− S	Remote sensing terminal for - output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to -V terminal when remote sensing function is unnecessary)
5	PC	Current balance terminal (For output current balancing in parallel operation.)
6	COM	Ground for PC and PV signal.
7	PV	Output voltage external control terminal (For power supply output voltage control with an external voltage. Connect it with the terminal REF when PV function is unnecessary.)
8	REF	Reference Voltage terminal for Output voltage control (REF and PV are connected when shipping.)
9	CNT	Remote ON/OFF control terminal (When the CNT is pulled to TTL low, the power supply turns on.)
10	TOG	Ground for CNT and PF signal.
11	PF	Power fail signal output terminal. (As the output voltage drops, FAN stops and AC input voltage down, open collector output, "Power Fail" signal will output "High".)
12	TOG	Ground for CNT and PF signal.

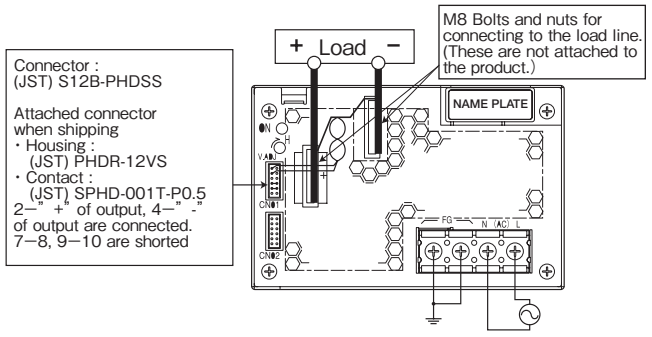
CN01, CN02 are connected in this power supply unit as follows.

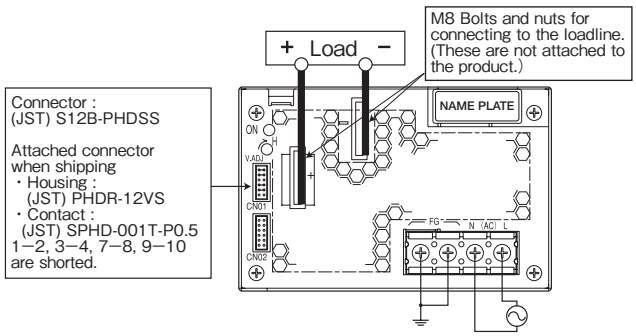


3 Basic Connection(Local sensing)

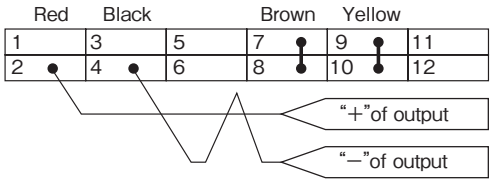
・3-7V model
①Connect "+S" terminal to "+" terminal of output and "-S" terminal to "-" terminal of output with sensing wires.
②Connect "CNT" terminal to "TOG" terminal with wire.
③Connect "PV" terminal to "REF" terminal with wire.
※ Please use attachment connector for each connection.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.

・12-60V model
① Connect "+S" terminal to "+V" terminal and "-S" terminal to "-V" terminal with sensing wires.
② Connect "CNT" terminal to "TOG" terminal with wire.
③ Connect "PV" terminal to "REF" terminal with wire.
※ Please use attachment connector for each connection.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.

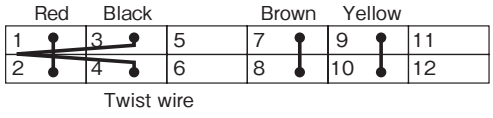




Attached connector when shipping

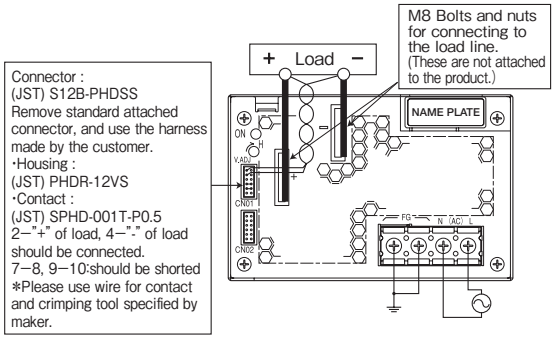


Attached connector when shipping

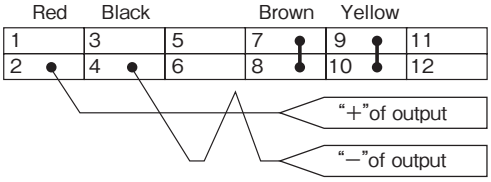


4 Remote sensing required

① Connect "+S" terminal to "+" terminal of load with sensing wire
② Connect "-S" terminal to "-" terminal of load with sensing wires.
③ Connect "CNT" terminal to "TOG" terminal with wire.
④ Connect "PV" terminal to "REF" terminal with wire.
※ The accuracy of the output voltage will deteriorate when the sensing terminals are opened.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.

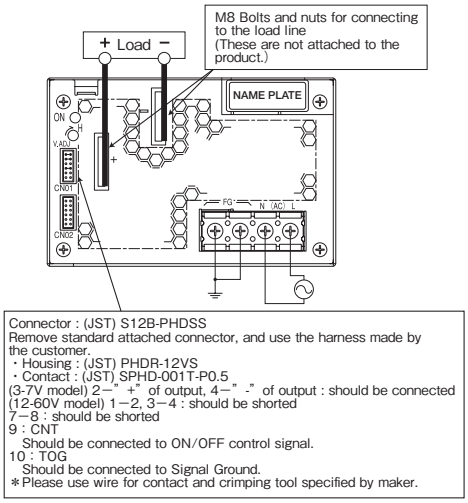


Connecting circuit with CN01 or CN02 connector

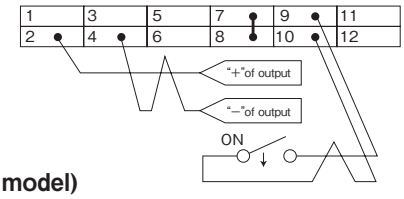


5 Remote ON/OFF control required

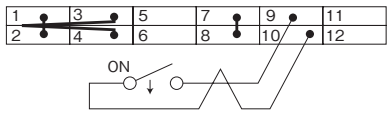
① Remote standard attached connector, and use the harness made by the customer and connect external signal to between CNT and TOG terminal.
② "TOG" terminal is ground for "CNT" terminal.
In case this function is not used, please short between CNT and TOG terminal.



● Connecting circuit with CN01 or CN02 connector
(3-7V model)

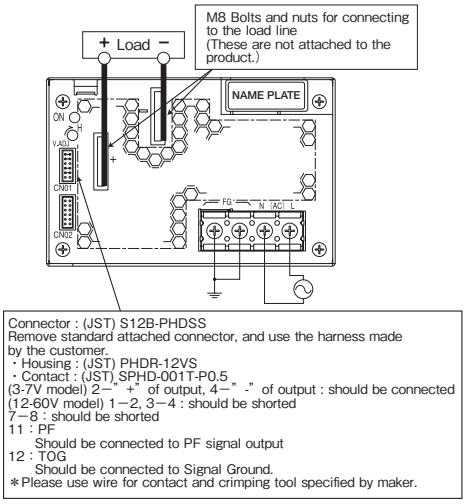


(12-60V model)

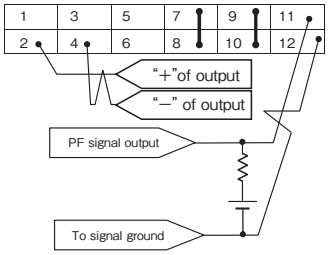


6 PF signal output required

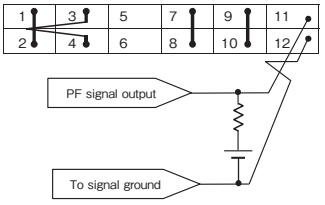
① PF signal is an open collector output, therefore PF signal outputs is shown in circuit below.
② "TOG" terminal is ground for "PF" terminal.



● Connecting circuit with CN01 or CN02 connector
(3-7V model)



(12-60V model)



2. Functions and Precautions

1 Input Voltage Range

Input voltage range is single phase 85—265VAC (47—63Hz). Input voltage, which is out of specification, may cause unit damage. Rated input voltage range fix during safety standard application is from100V to 240VAC (50/60Hz).
While applying input voltage from 85VAC to 90VAC, output load current derating is required.

2 Output Voltage Range

Output voltage is set to the rated value at shipping. V.ADJ trimmer on the front panel side is use to adjust the output voltage within the range specified. Output voltage trimming range is within -20% — +20% of the rated output voltage (48V, 60V Model: -20% — +10%). Turn the trimmer clockwise to increase output voltage. Take note when the output voltage is increased excessively over voltage protection (OVP) function may trigger and output voltage will shut down.
Use the output power of the power supply below the rated output power value when you raise the output voltage.

3 Over Voltage Protection (OVP)

The OVP function (Inverter shut down method, manual reset type) is provided. OVP function operates within 125-145% of the rated DC output voltage value value (3-7V model: 125-140%, 36V type: 125-138%, 48V type: 115-135, 60V model: 115-125%), and the output will be shut down when OVP function triggers. When OVP function operates, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal shall be input for recovery of the output. OVP value is fixed and can not be adjusted.

4 Over Current Protection (OCP)

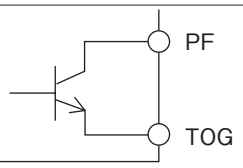
The OCP function (Constant current limiting, Time delay shutdown type) is provided. OCP function operates when the output current exceeds 105% of maximum DC output current specification and the over current or short circuit condition continues 5-second or more, the output will be shut down. When the OCP is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output. The OCP setting is fixed and not to be adjusted externally.

5 Over Temperature Protection (OTP)

Over temperature protection function (manual reset type) is provided. When ambient or internal temperature rises abnormally, OTP will shut down the output. When OTP is triggered, input power is cut off and allow sufficient cooling to reset the OTP function. Then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

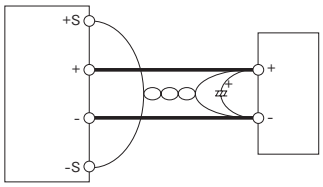
6 Low Output Detection Circuit (PF)

Low output voltage detection circuit is provided. Power Fail signal (PF signal) will output when output voltage decrease by either the drop or brown out of the input voltage or OCP, OVP and OTP function operation. PF signal will turn "High" level to indicate the abnormal status of the power supply when the output voltage decrease to 80% of the output voltage setting value. However, there is a possibility that PF signal may not output during parallel operation. The PF signal circuit is insulated from the power supply input and output circuit and it is an open collector. TOG terminal is ground for PF terminal.
When the Built-in Fan Motor of this power supply unit stops, PF signal will turn to "H" and the output power will shut down. The Built-in Fan Motor is a component with lifetime. We recommend a periodic replacement. Please contact our sales office. Replacement is at customer's expenses.



7 Remote Sensing (+S, -S terminal)

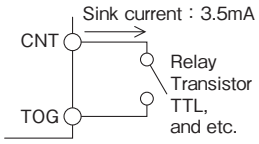
Remote sensing function is provided to compensate for voltage drop across the wiring from the power supply output terminals to the load input terminals. Connect "+S" terminal to "+" terminal of the load and "-S" terminal to "-" terminal of the load with sensing wires. The total line voltage drop (+ side line and - side line) shall be less than 0.3V. In case that sensing line is too long, it is necessary to put an electrolytic capacitor across the load terminals.
Please take note that the electrolytic capacitor has generation of heat etc. done by the ripple current depending on connected load. Therefore, the electrolytic capacitor must have a ripple current allowance higher then the output ripple current. If CN01 (or CN02) is in use, terminal +S, -S for CN02 (or CN01) must be in open condition.



When the function of remote sensing is not in used, connect +S terminal to +V terminal, and –S terminal to –V terminal by the attachment connector.
If remote sensing terminals are opened, the stability and the accuracy of the output deteriorate. Therefore, terminal +S, -S must be connected.

8 Remote ON/OFF Control

Remote ON/OFF control is provided. Output can be remotely switch ON and OFF by using CNT terminal and TOG terminal even though input is connected. The output is turned to ON when TOG and CNT terminals are shorted and output is turned to OFF when these terminals are opened. When the function is not used, connect TOG and CNT terminals with short piece. The standards for this function are as follows. "TOG" terminal is ground for "CNT" terminal.



The Mode of control

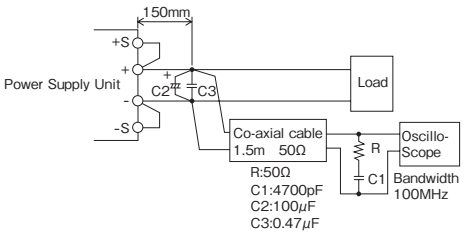
CNT Level for TOG Terminal	Output	Built-in Fan Motor
Short or L(0—0.8V)	ON	Rotate
Open or H(2.4—12V)	OFF	Stop

1) TTL compatible. The maximum input voltage to CNT terminal is 12V, and the maximum allowable reverse voltage is -1V. The sink current of CNT terminal is 3.5mA.
2) Output ON/OFF control can be enable by a switch, relay or a transistor ON/OFF. When CNT terminal—TOG terminal is shorted power supply is turn ON, and when CNT terminal—TOG terminal is opened power supply is turn OFF.
3) Remote ON/OFF control circuit is isolated from the input and output circuit of power supply.
It is possible to use it regardless of the positive and negative of the power supply output.

Please be aware that if CNT terminal and TOG terminal is short and input voltage is gradually increase, this will trigger the low output voltage detector protection circuit and will result to output voltage shut down.
When the low output voltage detector protection circuit is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

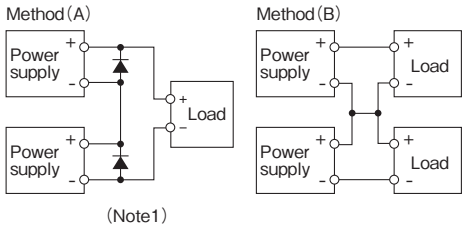
9 Output Ripple & Noise

Maximum ripple & noise value in specifications is measured according to measurement circuit specified by JEITA-RC9131A. When Load lines are longer, ripple & noise becomes larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal. The output ripple & noise cannot be measured accurately if the probe ground lead of oscilloscope is too long.



10 Series Operation

For series operation, either method (A) or (B) is possible.
There might be a step in the rise waveform during series operation.



(Note1)
Please connect a diode for by-pass when using method (A) of the series operation.
Please use the diode with rated forward current is equal or more than load current and that the rated maximum reverse voltage is higher than output voltage for each power supply.

11 Parallel Operation

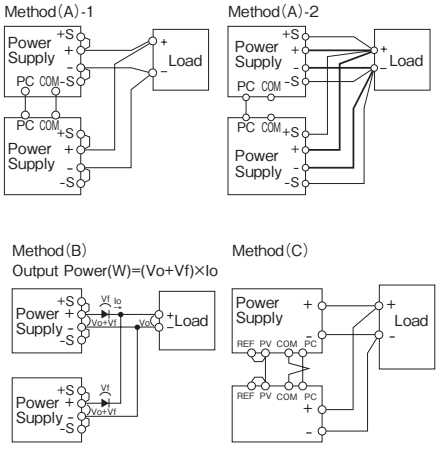
Current balancing function is provided. Either of operations mode (A) or (B) is possible.

(A) To Increase the Output Current
Current balancing function activates by connecting PC-to-PC terminal and COM-to-COM terminal, and output current of each power supply is equivalently supplied to load. Wires to PC terminals shall be as short as possible, same length and twisted.
There is a possibility that output could be unstable caused by external noise. For this case, disconnect COM terminal and connect -S terminal from parallel power supply to a single point on the load. Please refer connection Method (A)-2.

1) Adjust the output voltage of each power supply to be same value within 1% or 100mV, whichever is smaller.
2) Use same length and type of wires for all load lines.
3) Maximum value of output current in parallel is up to 80% of all paralleled models.The purpose of the current balancing function is the static power-up. Therefore the output voltage might decrease according to the condition of dynamic load. There might be a step in the rise waveform during parallel operation.
4) Up to 5 units can be connected in parallel.

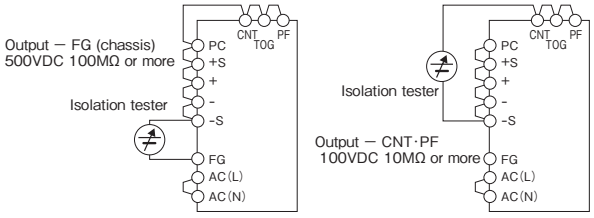
(B) To Use as a Backup Power Supply
1) Set power supply output voltage higher by the forward voltage drop of diode.
2) Adjust the output voltage of each power supply to be same value.
3) Use within the specifications for output voltage and output power.

(C) In the case of parallel connections, it is possible to control the output voltage by adjusting the volume from only 1 unit. Choose 1 unit that would act as the master and this unit's volume will determine the output voltage. The volume on each slave units must be turned clockwise to maximum position. Then adjust the master volume to set the output voltage.
Connection for this application is shown in figure (c).



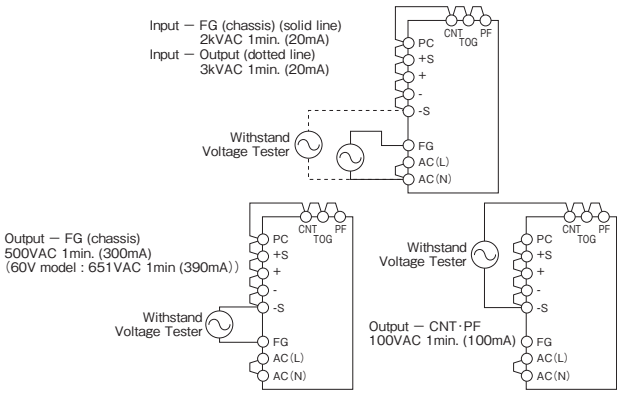
12 Isolation Test

Isolation resistance between output and FG (chassis) shall be more than 100MΩ at 500VDC and between output and CNT·PF shall be more than 10MΩ at 100VDC. For safety operation, voltage setting of DC isolation tester must be done before the test. Ensure that it is fully discharged after the test.



13 Withstand Voltage

This series is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and FG (chassis), 500VAC (60V model : 651VAC) between output and FG (chassis), and 100VAC between output and CNT·PF terminal each for 1 minute. When testing withstand voltage, set current limit of withstand voltage test equipment at 20mA.
(Output-FG (chassis) : 300mA (60V model : 390mA), Output- CNT·PF : 100mA).
The applied voltage must be gradually increased from zero to testing value and then gradually decreased for shut down. When timer is used, the power supply may be damaged by high impulse voltage at timer switch on and off. Connect input and output as follows. If output is left open during test, output voltage might appear momentarily.
This product have monolithic ceramic capacitor in secondary circuit to frame ground.
Some of the withstand voltage tester may generate high voltage at the matching with monolithic ceramic capacitor and may cause the unit damage.
So, please check the waveform of test voltage.

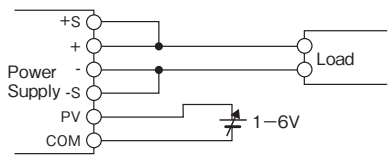


14 Output Voltage External Control (PV)

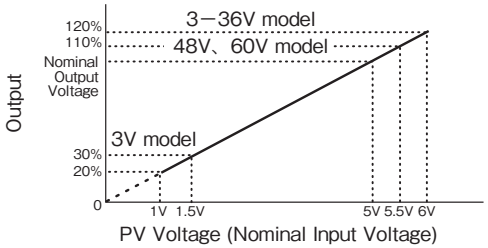
(A) Control by External Voltage

Output voltage external control function is provided. Output voltage can be varied by applying an external voltage (1−6V) to "PV" terminal and "COM" terminal. Note if an external voltage is not applied, there will be no output. Please consider the following characteristics below when operating the unit.

Connection Method

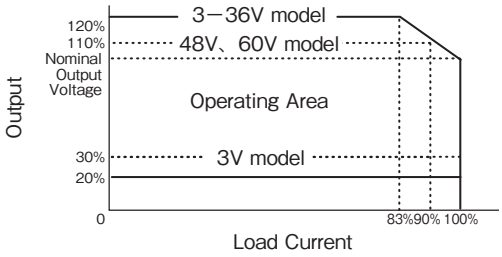


Output Voltage Linearity



Note: Only as for the model of 3V output, the output voltage is used from 30% to 120% at the PV voltage is from 1.5V to 6.0V
Note: Only as for the model of 5-36V output, the output voltage is used from 20% to 120% at the PV voltage is from 1V to 6.0 V
Note: Only as for the model of 48V, 60V output, the output voltage is used from 20% to 110% at the PV voltage is from 1V to 5.5V

Output Voltage Derating

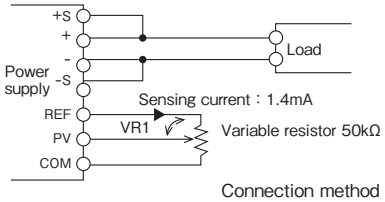


Note: Only as for the model of 48V, 60V output, the maximum output voltage is used up to 110% at 90% load current.

(B) Control by External Variable Resistor

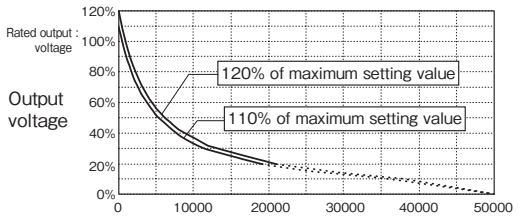
"PV" terminal and "COM" terminal usage is the same as explained in section「control by external voltage」. But in this method voltage for control is supplied through REF terminal. Variable resistor is connected between REF terminal and COM terminal and the middle point of variable resistor is connected to PV terminal. Please use the output voltage within 20% - 120% of rated output voltage value (3V model : 30% - 120%, 48V, 60V model : 20% - 110%). Wires for control lines must be twisted wire or shield wire. In addition, maximum variable voltage when control by external variable resistor is rated output voltage (100%). When output voltage must be externally control to 120% of rated output voltage (110% for 48V, 60V model), please follow the following procedure.

(1) PV terminal and REF terminal is short by using standard connector supplied.
(2) Set the power supply output voltage to maximum value of the output voltage variable range mentioned in specification standard by adjusting V.ADJ volume at the front panel.
(3) Remove standard connector after input is cut off.
(4) Connect external variable resistor (50kΩ) between REF terminal and COM terminal. Then connect middle point of external variable resistor to PV terminal. (sensing current is 1.4mA)



Connection method

When output voltage is over rated value, please make sure that maximum output power is below rated value. Moreover, when output voltage is below rated value, please make sure that maximum output current is below rated value.
Please consider the following characteristic during usage.



* Adjustable output voltage within 20% (3Vmodel : 30%) of output (less than 1V of PV voltage) is proportional to PV voltage and has a linear characteristic. However, for output voltage within 10% of output (about less than 0.5V of PV voltage), output will go into intermittent mode and ripple voltage becomes large, also irregular sound is release from the power supply. However, it is not damage. There will also be cases of the power supply shutting down triggered by under voltage lock out protection function. With output shutting down, low output detection function (PF) triggers the PF signal and set it to "H", and also output LED is switch off. Under voltage lock out protection mode, switch off input for a few minutes and then switch on input again for recovery. Recovery from under voltage lock out is also possible by turning remote ON/OFF control signal OFF and ON. Under voltage detection value uses an automatic tracking mode, which follows the output voltage and constantly correspond to the 70%-80% of output voltage with a protection function mode. Base on the explanation above, we will kindly exclude the usage of adjustable output voltage within 20% of the output voltage from the product warranty. For application that requires variable output voltage within 20% of output voltage, please kindly consider the above contents prior to operation. For application that requires output voltage below 20%, due to different type of application for the user's system, there might be a situation (behavior) different from the one mentioned above. Therefore please check with the user system.

15 Output Peak Current

For model with output peak current, please meet the following condition.Reduce peak current value according to output derating as section 4-1.

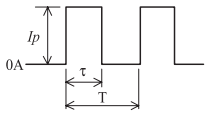
The output is shut down by protection circuit when rated current and continuous peak output time (τ) exceeds rated value during usage.

When protection circuit is activated, input is temporarily cut off for a few minutes and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

Input voltage range : AC180V - 265V
Continuous Peak output time. (τ): Within 10 seconds
Peak output current (Ip): Within the rated peak output current
Duty : up to 35%

$$\text{Duty} = \frac{\tau}{T} \times 100\ (\%)$$

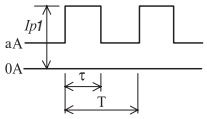
Condition 1



Model	Irms max
HWS1500-6	177.5A
HWS1500-7	142.0A
HWS1500-24	62.1A
HWS1500-36	41.4A
HWS1500-60	24.8A

$$\sqrt{Ip^2 \times \frac{\tau}{T}} \leq \text{Irms max}$$

Condition 2



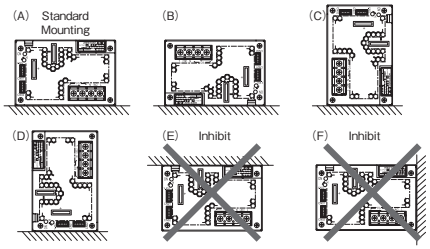
$$\sqrt{(Ip1^2 \times \frac{\tau}{T} + a^2 \times (1 - \frac{\tau}{T})} \leq \text{Irms max}$$

Ip, Ip1 : Peak output current(A)
Irms : Effective current(A)
τ : Peak current pulse width(sec)
T : cycle(sec)

3. Mounting Directions

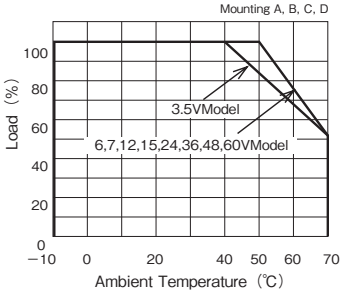
1 Output Derating

Mounting directions are as follows.
Standard mounting method is (A). Methods (B), (C) and (D) are also possible. Mounting methods besides (A), (B), (C) and (D) (example: (E) and (F)) are inhibit.



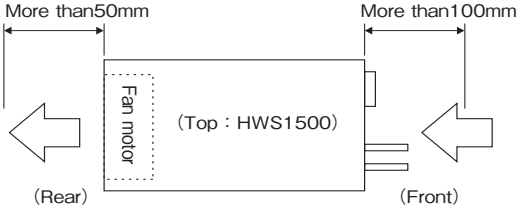
HWS1500 Output Derating

3, 5V Ta(℃)	6-60V Ta(℃)	LOAD(%)			
		A	B	C	D
−10 - +40	−10 - +50	100	100	100	100
70	70	50	50	50	50



2 Mounting Method Caution

(1) This Power supply unit is a forced air-cooling system with a built-in fan.
(2) This power supply has ventilating holes on the front and back panels.
Keep these areas freely more than 100mm from front side and more than 50mm from rear side.
(3) Please note that ventilation will be worsened in a dusty environment.
(4) Built-in fan is limited life part, which require periodic replacement. (Replacement will be charge).
(5) The ambient temperature of this power supply is less than 50mm from the center of a front side.
(6) The maximum allowable penetration of mounting screw is 6mm.
(7) Recommended torque for mounting screw (M4) is 1.27N・m.

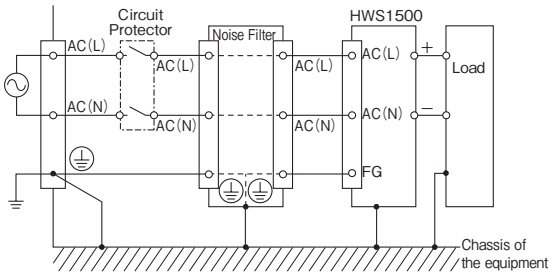


4. Wiring Method

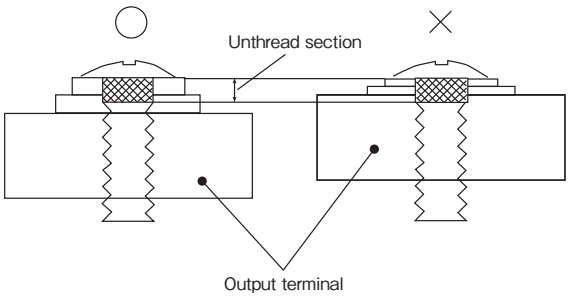
(1) The output load line and input line shall be separated and twisted to improve noise sensitivity.
(2) The sensing lines shall be twisted or shield wire and separated from the output lines.
(3) Use all lines as thick and short as possible to make lower impedance. Wires are to be twisted or use shield wire to improve noise sensitivity.
(4) Attaching a capacitor to the load terminals can eliminate noise.
(5) FG terminal of this power supply is functional earthing.
For safety purposes, connect protective earthing terminal to the mounting set ground terminal.
(6) Recommended torque for the terminal piece:

Input terminal (M4 screw) : 1.27 N·m Output terminal (M8 Bolt & Nut) : 10.8N・m

(7) Recommended wiring



(8) M4 screw for output terminal might damage the terminal's inner thread. This is mainly cause by the M4 screw's unthread section. Therefore, please select a washer, spring washer, etc. to avoid unthread screw section from penetrating into output terminal inner section.



5. External Fuse Rating

Refer to the following fuse rating when selecting the external fuses for input line. Surge current flows when line turns on. Use slow-blow fuse or time-lug fuse. Do not use fast-blow fuse. Fuse rating is specified by in-rush current value at line turn-on. Do not select the fuse according to input current (rms.) values under the actual load condition.

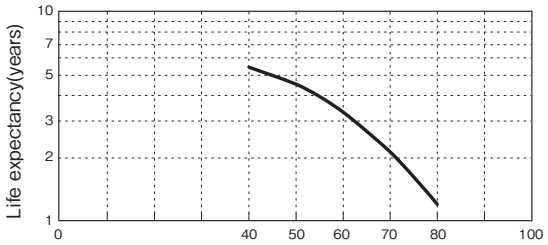
HWS1500 : 30A

6. Troubleshooting

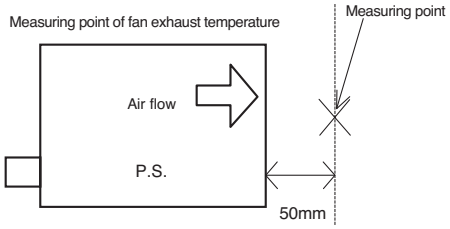
Before concluding that the unit is at fault, make the following checks.
(1) Check if the rated input voltage is apply.
(2) Check if the wiring of input and output is correct.
(3) Check if the I/O terminal connection is properly tighten by a regulated tightening torque.
(4) Check if the wire material is not too thin.
(5) Check if the output voltage control (V.ADJ) is properly adjusted. OVP might be trigged and output is cut off.
(6) Check if the wiring of "+S" and "-S" terminal is correct.
If in open condition, the stability and the accuracy of the output deteriorate.
(7) If use function of the remote ON/OFF control, check if the remote ON/OFF control connector is not opened.
If in open condition, output is cut off.
(8) Check if the built-in fan is not stopped. Is fan stopped by something irregulars or dust, etc.
If fan stops, the PF signal is turn on.
Moreover, the output is intercepted with the protection circuit if fan stops.
Fans are the limited life parts.
(9) This power supply has ventilating holes on the front and back panels. Check if there is any irregulars or dust, etc.
(10) Is the main body of the power supply abnormally hot?
Please turn on the input again after allowing the unit to cool down sufficiently. The output shut down by over temperature protection function.
(11) Check if the output current and output power is not applied over specification.
(12) Check if the input voltage wave is sinusoidal. If this power supply unit is connected to a UPS, input voltage wave might not be sinusoidal. An audible noise is emmited from the power supply unit.
(13) Audible noise can be heard during Dynamic-Load operation.

7. Warranty

This product is warranted for a period of 5 years from the date of shipment. As for the breakdown under a normal use during free warrantee term, repair is at free of charge. However, the Built-in Fan Motor replacement is for a fee. Please contact your nearest sales office for replacement.
The Fan-life has limitation. Therefore, periodic maintenance by replacing the life-expired fan is required.
The following figure shows the life of fan.



Life expectancy Fan exhaust temperature 45℃ 45,000 hour
Fan exhaust temperature 80℃ 11,000 hour

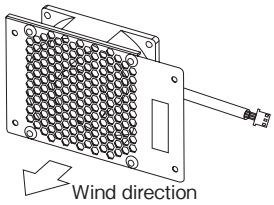


Please read the General Safety Instruction before using the products.

8. Option

1 Fan unit for replacement

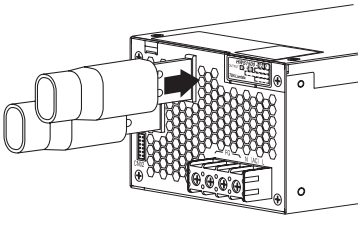
We have prepared an optional fan unit for replacement.

Name of fan unit for replacement	Applicable models	Appearance	Pin assignments	Price
1500-FAN-01	HWS1000 HWS1500 HWS1800T (of standard specifications)		Housing = XHP-3(J.S.T.) Contact = SXH-001T-P0.6(J.S.T.) Pin No. / Description 1 Power supply 2 Fan alarm 3 GND Length of fan harness = 65 ± 10mm	Open

Ask us for replacement of the fan. This will be a charged service. If you are replacing the fan by yourself, note the following.
*1. Be careful in handling the fan unit so as not to cause an impact by dropping it or hitting it, etc.
*2. Shut down the input before starting the replacement operation.
*3. Check that there are no loose parts in connectors or harness tucking, etc.
*4. Safety standards (UL, CE, etc.) are not applicable.

2 Insulation tube for HWS1500

The following insulation tube can becuse for output terminal.
・TCV-2001 (shinagawa shoko)
Please confirm shape and size from manufacturer catalog.



Example of use for insulation tube

HWS 1800T Series Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read the following precautions thoroughly before using this power supply unit.
Pay attention to all warnings and cautions before using the unit. Incorrect usage could lead to an electrical shock, damage to the unit or a fire hazard.

⚠ WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void your warranty.
- Do not touch the internal components; they may have high voltage or high temperature. You may get electrical shock or burned.
- When the unit is operating, keep your hands and face away from it; an accident may injure you.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock.
  In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire, when using the unit under such condition.
- Do not operate these units at the condition of condensation. It may cause fire and electric shock.
- Power supplies with an output voltage of 48Vdc or less must be earthed in the end use equipment to maintain SELV.
  If the outputs are not earthed, they must be considered hazardous and must not be made user accessible.
- Power supplies with an output voltage of 60Vdc are considered to be non-SELV. As a result of this, the output must be guarded or a deflector fitted during installation to avoid a SERVICE ENGINEER making inadvertent contact with the output terminals, or dropping a tool onto them. The output of this product must not be connected to a SELV circuit.

Note : CE MARKING

- CE Marking when applied to a product covered by this handbook indicates compliance with the low voltage directive (2006/95/EC) in that it complies with EN60950-1.

⚠ CAUTION

- This power supply is primarily designed and manufactured to use and enclose in other equipment.
- This power supply unit has a built-in fan for air-cooling. Do not block air intake and exhaust. It might cause fire.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.
- The unit might be broken down by accident or unexpected situation. For application equipment, which requires very high reliability (nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not make an improper wiring to input and output terminals. It may cause damage.
- Do not use in environment such as strong electromagnetic field, erosive gas etc, or any environment where conductive foreign substance may enter.
- Do not operate and store this unit at the condition of condensation. In such case, waterproof treatment is necessary.
- Do not operate this unit after it falls down.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240VA or more), prevention from direct contact with voltage output is highly necessary. While installing or servicing this power supply unit, avoid dropping tools by mistake or direct contact with voltage output. This might cause an electrical shock.
  While repairing this power supply unit, the AC input power must be switch off and the I/O terminal voltage should be less than the safety level.

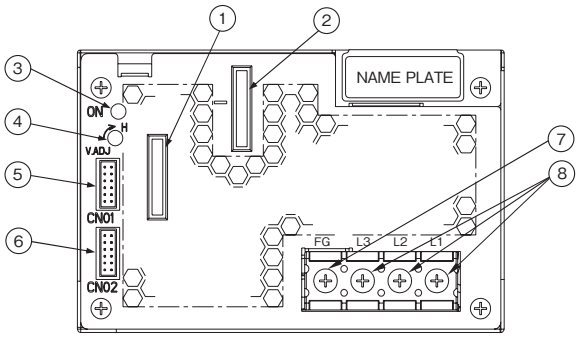
1. Terminal Explanation

Please pay extra attention to the wiring. Incorrect connection will damage the power supply.

- When connecting input and output wiring, input AC-Line should be off.
- Input wiring and output wiring shall be separated, otherwise noise susceptibility of power supply unit will be weak.
- The protective earth (PE) must be connected to the instrument chassis and the chassis of this power supply unit.
- Remote sensing lines shall be twisted or use the shielded wire.
- Remote ON/OFF control lines shall be twisted or use the shielded wire.

1 Front Panel Explanation

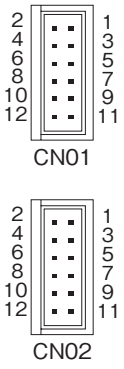
HWS1800T Front Panel



① + : + Output terminal
② − : − Output terminal
③ ON : Output (Power On) indication green LED
(The indicator turns on when the power supply output is in normal operating condition.)
④ V.ADJ : Output voltage adjust trimmer
(The output voltage rises when trimmer is turned clockwise.)
⑤ CN01 : } Remote sensing, ON/OFF control signal, Current balance signal,
⑥ CN02 : } Output voltage external control signal and Power fail signal output connector.
⑦ FG : Function Ground terminal (Frame ground)
⑧ L1,L2,L3 : Three phase AC input terminal (Fuse in each line)

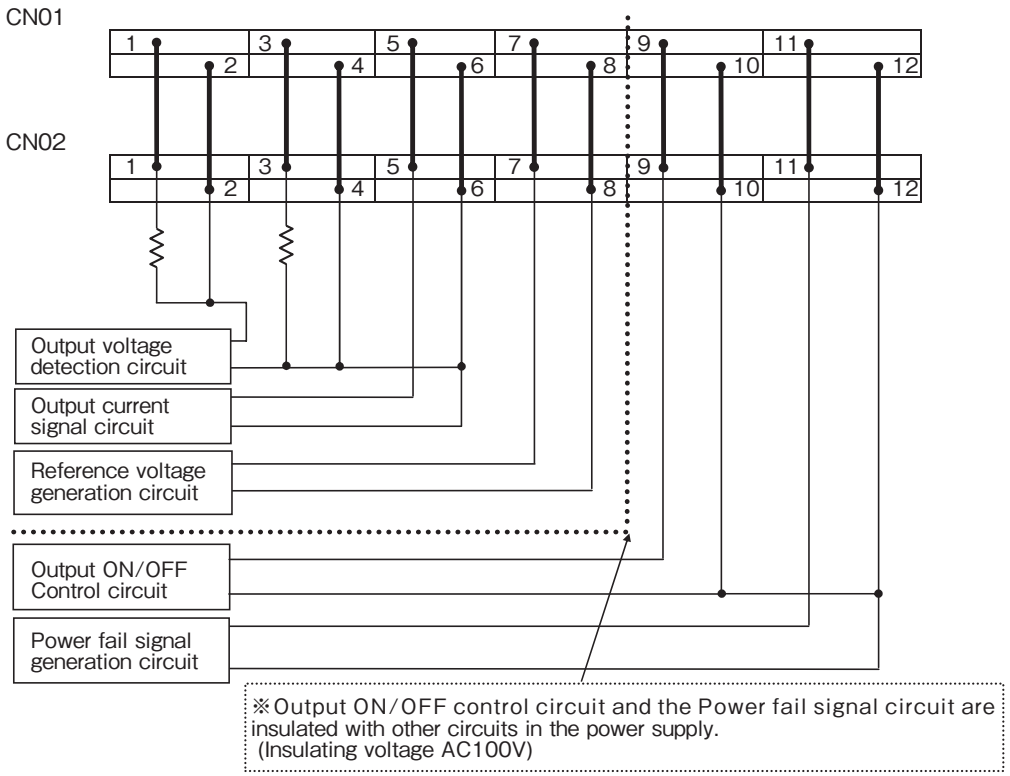
2 CN01, CN02 Connector pin configuration and function

CN01, CN02 pin configuration and function are the same.
They are connected to each other in this power supply unit.
When the pin of CN01 side is shorted the same function pins of CN02 side are shorted.
Please note that the function cannot be separately set with CN01 and CN02.



Pin No.	Configuration	Function
1	+V	Connected to +Output terminal in this Power supply unit. (+V terminal can not supply load current.)
2	+S	Remote sensing terminal for + output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to +V terminal when remote sensing function is unnecessary)
3	−V	Connected to -Output terminal in this Power supply unit. (-V terminal can not supply load current)
4	−S	Remote sensing terminal for - output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to -V terminal when remote sensing function is unnecessary)
5	PC	Current balance terminal (For output current balancing in parallel operation.)
6	COM	Ground for PC and PV signal.
7	PV	Output voltage external control terminal (For power supply output voltage control with an external voltage. Connect it with the terminal REF when PV function is unnecessary.)
8	REF	Reference Voltage terminal for Output voltage control (REF and PV are connected when shipping.)
9	CNT	Remote ON/OFF control terminal (When the CNT is pulled to TTL low, the power supply turns on.)
10	TOG	Ground for CNT and PF signal.
11	PF	Power fail signal output terminal. (As the output voltage drops, FAN stops and AC input voltage down, open collector output, “Power Fail” signal will output “High” .)
12	TOG	Ground for CNT and PF signal.

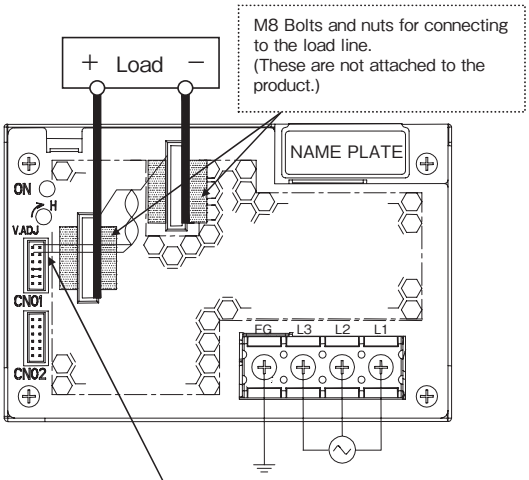
CN01、CN02 are connected in this power supply unit as follows.



3 Basic Connection (Local sensing)

• 3-7V model

① Connect "+S" terminal to "+" terminal of output and "-S" terminal to "-" terminal of output with sensing wires.
② Connect "CNT" terminal to "TOG" terminal with wire.
③ Connect "PV" terminal to "REF" terminal with wire.
※ Please use attachment connector for each connection.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.



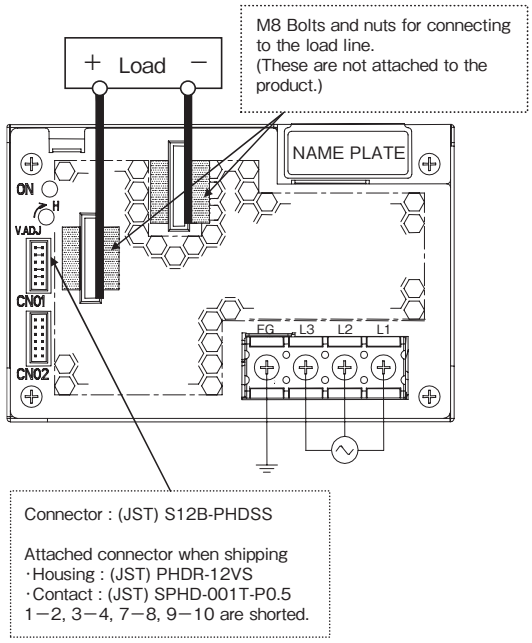
Attached connector when shipping

Red		Black			Brown		Yellow		
1	3	5	7	9	11
2	4	6	8	10	12

"+"of output
"−" of output

• 12-60V model

① Connect "+S" terminal to "+V" terminal and "-S" terminal to "-V" terminal with sensing wires.
② Connect "CNT" terminal to "TOG" terminal with wire.
③ Connect "PV" terminal to "REF" terminal with wire.
※ Please use attachment connector for each connection.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.



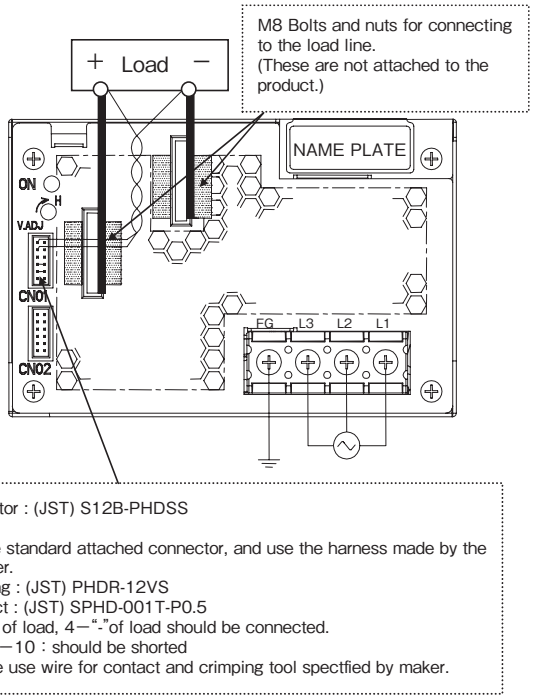
Attached connector when shipping

Red		Black			Brown		Yellow		
1	3	5	7	9	11
2	4	6	8	10	12

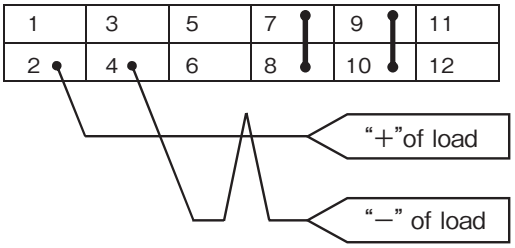
Twist wire

4 Remote sensing required

① Connect "+S" terminal to "+" terminal of load with sensing wire
② Connect "-S" terminal to "-" terminal of load with sensing wires.
③ Connect "CNT" terminal to "TOG" terminal with wire.
④ Connect "PV" terminal to "REF" terminal with wire.
※ The accuracy of the output voltage will deteriorate when the sensing terminals are opened.
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.

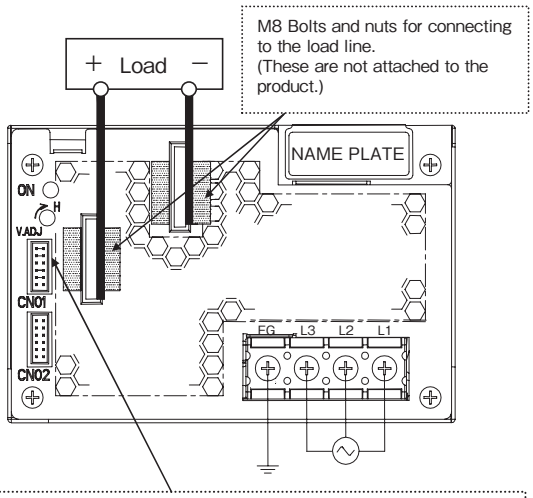


Connecting circuit with CN01 or CN02 connector



5 Remote ON/OFF control required

① Remove standard attached connector, and use the harness made by the customer and connect external signal to between CNT and TOG terminal.
② "TOG" terminal is ground for "CNT" terminal.
In case this function is not used, please short between CNT and TOG terminal.

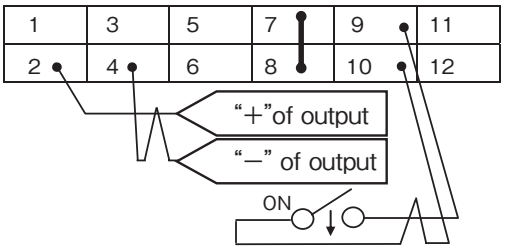


Connector : (JST) S12B-PHDSS

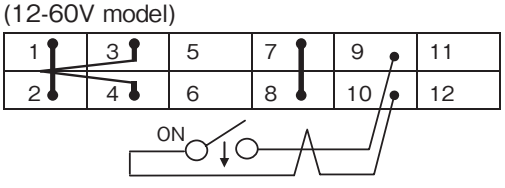
Remove standard attached connector, and use the harness made by the customer.
·Housing : (JST) PHDR-12VS
·Contact : (JST) SPHD-001T-P0.5
(3-7V model) 2−"+"of output, 4−"-"of output : should be connected
(12-60V model) 1−2, 3−4 : should be shorted
7−8 : should be shorted
9 : CNT
Should be connected to ON/OFF control signal.
10 : TOG
Should be connected to Signal Ground.
* Please use wire for contact and crimping tool spectfied by maker.

Connecting circuit with CN01 or CN02 connector

(3-7V model)

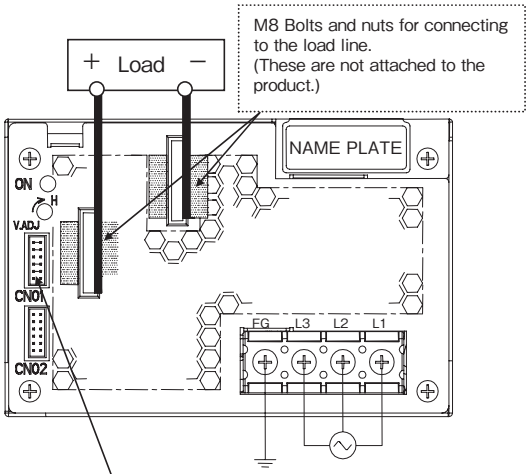


(12-60V model)



6 PF signal output required

① PF signal is an open collector output, therefore PF signal outputs is shown in circuit below.
② "TOG" terminal is ground for "PF" terminal.

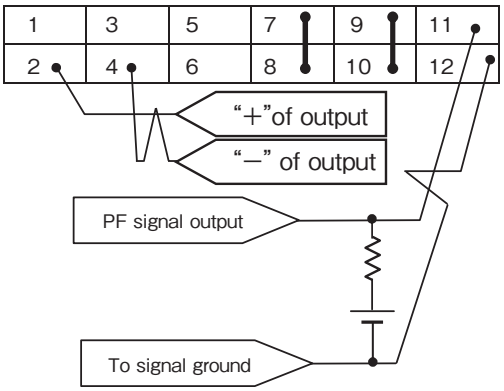


Connector : (JST) S12B-PHDSS

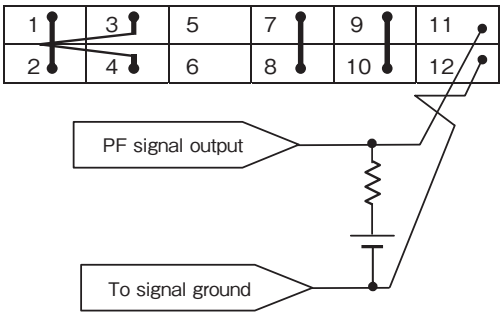
Remove standard attached connector, and use the harness made by the customer.
·Housing : (JST) PHDR-12VS
·Contact : (JST) SPHD-001T-P0.5
(3-7V model) 2−"+"of output, 4−"-"of output : should be connected
(12-60V model) 1−2, 3−4 : should be shorted
7−8 , 9−10 : should be shorted.
11 : PF
Should be connected to PF signal output
12 : TOG
Should be connected to Signal Ground.
* Please use wire for contact and crimping tool spectfied by maker.

Connecting circuit with CN01 or CN02 connector

(3-7V model)



(12-60V model)



2. Functions and Precautions

1 Input Voltage Range

Input voltage range is three phase 170−265VAC(47−63Hz). Input voltage, which is out of specification, may cause unit damage. Rated input voltage range fix during safety standard application is from 200V to 240VAC (50/60Hz).

2 Output Voltage Range

Output voltage is set to the rated value at shipping. V.ADJ trimmer on the front panel side is use to adjust the output voltage within the range specified. Output voltage trimming range is within -20% − +20% of the rated output voltage (48V, 60V model: -20% − +10%). Turn the trimmer clockwise to increase output voltage. Take note when the output voltage is increased excessively over voltage protection (OVP) function may trigger and output voltage will shut down.

Use the output power of the power supply below the rated output power value when you raise the output voltage.

3 Over Voltage Protection (OVP)

The OVP function (Inverter shut down method, manual reset type) is provided. OVP function operates within 125-145% of the rated DC output voltage value (3-7V model: 125-140%, 36V model: 125-138%, 48V, 60V model: 115-125%), and the output will be shut down when OVP function triggers. When OVP function operates, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal shall be input for recovery of the output. OVP value is fixed and can not be adjusted.

4 Over Current Protection (OCP)

The OCP function (Constant current limiting, Time delay shutdown type) is provided. OCP function operates when the output current exceeds 105% of maximum DC output current specification and the over current or short circuit condition continues 5-second or more, the output will be shut down. When the OCP is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output. The OCP setting is fixed and not to be adjusted externally.

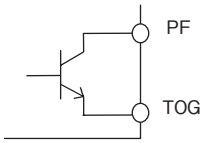
5 Over Temperature Protection (OTP)

Over temperature protection function (manual reset type) is provided. When ambient or internal temperature rises abnormally, OTP will shut down the output. When OTP is triggered, input power is cut off and allow sufficient cooling to reset the OTP function. Then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

6 Low Output Detection Circuit (PF)

Low output voltage detection circuit is provided. Power Fail signal (PF signal) will output when output voltage decrease by either the drop or brown out of the input voltage or OCP, OVP and OTP function operation. PF signal will turn "High" level to indicate the abnormal status of the power supply when the output voltage decrease to 80% of the output voltage setting value. However, there is a possibility that PF signal may not output during parallel operation. The PF signal circuit is insulated from the power supply input and output circuit and it is an open collector. TOG terminal is ground for PF terminal.

When the Built-in Fan Motor of this power supply unit stops, PF signal will turn to "H" and the output power will shut down. The Built-in Fan Motor is a component with lifetime. We recommend a periodic replacement. Please contact our sales office. Replacement is at customer's expenses.

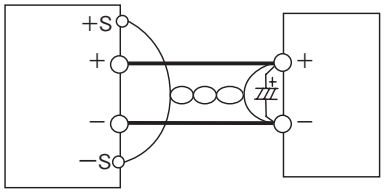


Vce max:30V
Ic max:20mA

7 Remote Sensing (+S, -S terminal)

Remote sensing function is provided to compensate for voltage drop across the wiring from the power supply output terminals to the load input terminals. Connect "+S" terminal to "+" terminal of the load and "-S" terminal to "-" terminal of the load with sensing wires. The total line voltage drop (+ side line and - side line) shall be less than 0.3V. In case that sensing line is too long, it is necessary to put an electrolytic capacitor across the load terminals.

Please take note that the electrolytic capacitor has generation of heat etc. done by the ripple current depending on connected load. Therefore, the electrolytic capacitor must have a ripple current allowance higher then the output ripple current. If CN01 (or CN02) is in use, terminal +S, -S for CN02 (or CN01) must be in open condition.

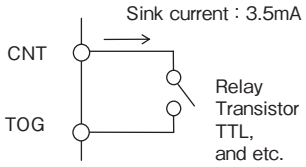


When the function of remote sensing is not in used, connect +S terminal to +V terminal, and –S terminal to –V terminal by the attachment connector.

If remote sensing terminals are opened, the stability and the accuracy of the output deteriorate. Therefore, terminal +S, -S must be connected.

8 Remote ON/OFF Control

Remote ON/OFF control is provided. Output can be remotely switch ON and OFF by using CNT terminal and TOG terminal even though input is connected. The output is turned to ON when TOG and CNT terminals are shorted and output is turned to OFF when these terminals are opened. When the function is not used, connect TOG and CNT terminals with short piece. The standards for this function are as follows. "TOG" terminal is ground for "CNT" terminal.



The Mode of control

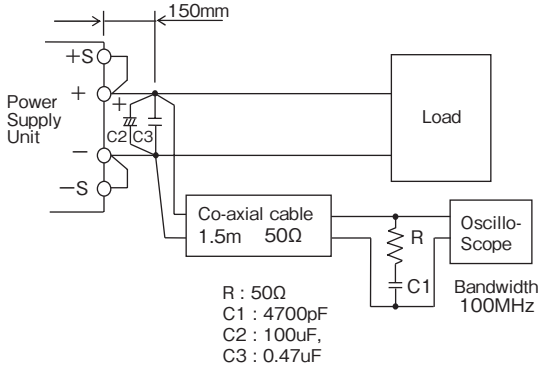
CNT Level for TOG Terminal	Output	Built-in Fan Motor
Short or L(0−0.8V)	ON	Rotate
Open or H(2.4−12V)	OFF	Stop

1) TTL compatible. The maximum input voltage to CNT terminal is 12V, and the maximum allowable reverse voltage is -1V. The sink current of CNT terminal is 3.5mA.
2) Output ON/OFF control can be enable by a switch, relay or a transistor ON/OFF. When CNT terminal−TOG terminal is shorted power supply is turn ON, and when CNT terminal−TOG terminal is opened power supply is turn OFF.
3) Remote ON/OFF control circuit is isolated from the input and output circuit of power supply.
It is possible to use it regardless of the positive and negative of the power supply output.

Please be aware that if CNT terminal and TOG terminal is short and input voltage is gradually increase, this will trigger the low output voltage detector protection circuit and will result to output voltage shut down.
When the low output voltage detector protection circuit is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

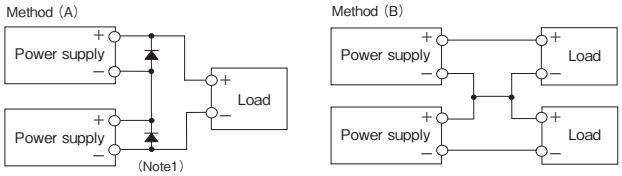
9 Output Ripple & Noise

Maximum ripple & noise value in specifications is measured according to measurement circuit specified by JEITA-RC9131A. When Load lines are longer, ripple & noise becomes larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal. The output ripple & noise cannot be measured accurately if the probe ground lead of oscilloscope is too long.



10 Series Operation

For series operation, either method (A) or (B) is possible.
There might be a step in the rise waveform during series operation.



(Note1)Please connect a diode for by-pass when using method (A) of the series operation. Please use the diode with rated forward current is equal or more than load current and that the rated maximum reverse voltage is higher than output voltage for each power supply.

11 Parallel Operation

Current balancing function is provided. Either of operations mode (A) or (B) is possible.

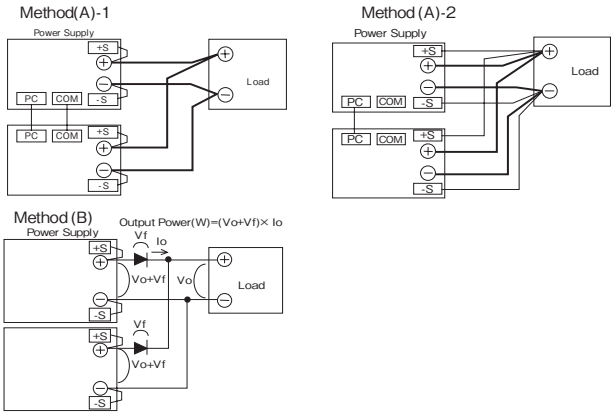
(A) To Increase the Output Current

Current balancing function activates by connecting PC-to-PC terminal and COM-to-COM terminal, and output current of each power supply is equivalently supplied to load. Wires to PC terminals shall be as short as possible, same length and twisted.
There is a possibility that output could be unstable caused by external noise. For this case, disconnect COM terminal and connect -S terminal from parallel power supply to a single point on the load. Please refer connection Method (A)-2.

1) Adjust the output voltage of each power supply to be same value within 1% or 100mV, whichever is smaller.
2) Use same length and type of wires for all load lines.
3) Maximum value of output current in parallel is up to 80% of all paralleled models.The purpose of the current balancing function is the static power-up. Therefore the output voltage might decrease according to the condition of dynamic load. There might be a step in the rise waveform during parallel operation.
4) Up to 5 units can be connected in parallel.

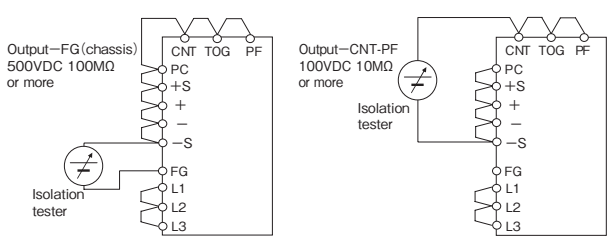
(B) To Use as a Backup Power Supply

1) Set power supply output voltage higher by the forward voltage drop of diode.
2) Adjust the output voltage of each power supply to be same value.
3) Use within the specifications for output voltage and output power.



12 Isolation Test

Isolation resistance between output and FG (chassis) shall be more than 100Ω at 500VDC and between output and CNT·PF shall be more than 10MΩ at 100VDC. For safety operation, voltage setting of DC isolation tester must be done before the test. Ensure that it is fully discharged after the test.



13 Withstand Voltage

This series is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and FG (chassis), 500VAC (60V model: 651VAC) between output and FG (chassis), and 100VAC between output and CNT·PF terminal each for 1 minute. When testing withstand voltage, set current limit of withstand voltage test equipment at 20mA.

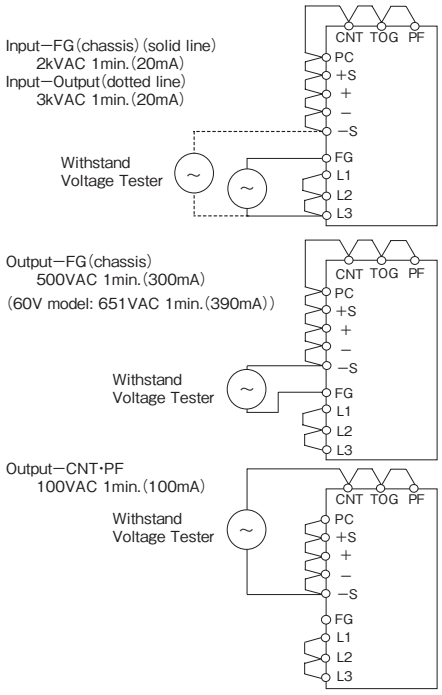
(Output-FG (chassis): 300mA (60V model: 390mA), Output- CNT·PF : 100mA).

The applied voltage must be gradually increased from zero to testing value and then gradually decreased for shut down. When timer is used, the power supply may be damaged by high impulse voltage at timer switch on and off. Connect input and output as follows. If output is left open during test, output voltage might appear momentarily.

This product have monolithic ceramic capacitor in secondary circuit to frame ground.

Some of the withstand voltage tester may generate high voltage at the matching with monolithic ceramic capacitor and may cause the unit damage.

So, please check the waveform of test voltage.

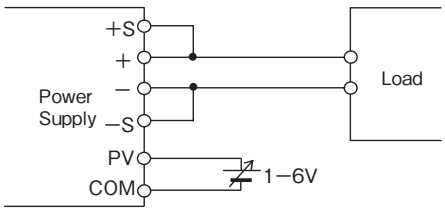


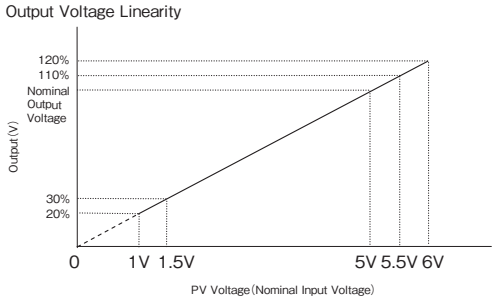
14 Output Voltage External Control (PV)

(A) Control by External Voltage

Output voltage external control function is provided. Output voltage can be varied by applying an external voltage (1—6V) to "PV" terminal and "COM" terminal. Note if an external voltage is not applied, there will be no output. Please consider the following characteristics below when operating the unit.

Connection Method

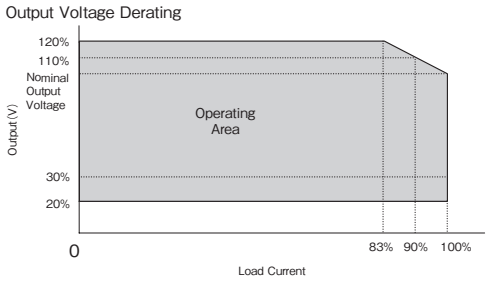




Note: Only as for the model of 3V output, the output voltage is used from 30% to 120% at the PV voltage is from 1.5V to 6V

Note: Only as for the model of 5-36V output, the output voltage is used from 20% to 120% at the PV voltage is from 1V to 6V

Note: Only as for the model of 48V, 60V output, the output voltage is used from 20% to 110% at the PV voltage is from 1V to 5.5V



Note: Only as for the model of 48V, 60V output, the maximum output voltage is used up to 110% at 90% load current.

(B) Control by External Variable Resistor

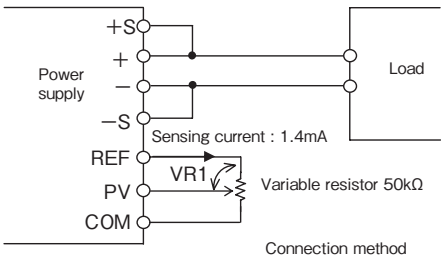
"PV" terminal and "COM" terminal usage is the same as explained in section「control by external voltage」. But in this method voltage for control is supplied through REF terminal. Variable resistor is connected between REF terminal and COM terminal and the middle point of variable resistor is connected to PV terminal. Please use the output voltage within 20% - 120% of rated output voltage value (48V, 60V model: 20% - 110%). Wires for control lines must be twisted wire or shield wire. In addition, maximum variable voltage when control by external variable resistor is rated output voltage (100%). When output voltage must be externally control to 120% of rated output voltage (110% for 48V, 60V model), please follow the following procedure.

(1) PV terminal and REF terminal is short by using standard connector supplied.

(2) Set the power supply output voltage to maximum value of the output voltage variable range mentioned in specification standard by adjusting V.ADJ volume at the front panel.

(3) Remove standard connector after input is cut off.

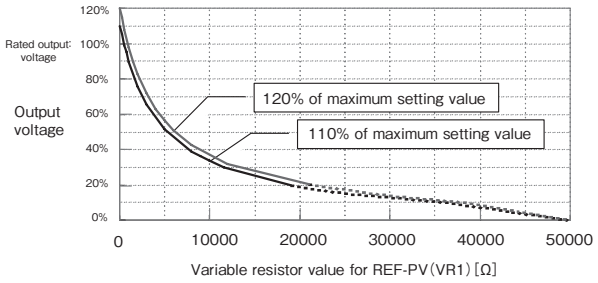
(4) Connect external variable resistor (50kΩ) between REF terminal and COM terminal. Then connect middle point of external variable resistor to PV terminal.(sensing current is 1.4mA)



When output voltage is over rated value, please make sure that maximum output power is below rated value. Moreover, when output voltage is below rated value, please make sure that maximum output current is below rated value.

Please consider the following characteristic during usage.

Please consider the following characteristic during usage.



* Adjustable output voltage within 20%(3Vmodel : 30%) of output (less than 1V of PV voltage) is proportional to PV voltage and has a linear characteristic. However, for output voltage within 10% of output (about less than 0.5V of PV voltage), output will go into intermittent mode and ripple voltage becomes large, also irregular sound is release from the power supply. However, it is not damage. There will also be cases of the power supply shutting down triggered by under voltage lock out protection function. With output shutting down, low output detection function (PF) triggers the PF signal and set it to "H", and also output LED is switch off. Under voltage lock out protection mode, switch off input for a few minutes and then switch on input again for recovery. Recovery from under voltage lock out is also possible by turning remote ON/OFF control signal OFF and ON. Under voltage detection value uses an automatic tracking mode, which follows the output voltage and constantly correspond to the 70%-80% of output voltage with a protection function mode. Base on the explanation above, we will kindly exclude the usage of adjustable output voltage within 20% of the output voltage from the product warranty. For application that requires variable output voltage within 20% of output voltage, please kindly consider the above contents prior to operation. For application that requires output voltage below 20%, due to different type of application for the user's system, there might be a situation (behavior) different from the one mentioned above. Therefore please check with the user system.

15 Output Peak Current

For model with output peak current, please meet the following condition.

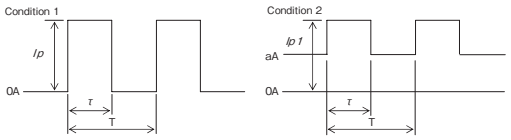
Reduce peak current value according to output derating as section 4-1.

The output is shut down by protection circuit when rated current and continuous peak output time (τ) exceeds rated value during usage.

When protection circuit is activated, input is temporarily cut off for a few minutes and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

Continuous Peak output time.(τ) : Within 10 seconds
Peak output current(Ip) : Within the rated peak output current
Duty : up to 35%

$$\text{Duty} = \frac{\tau}{T} \times 100(\%)$$



$\sqrt{Ip^2 \times \frac{\tau}{T}} \leq$ Irms max $\qquad \sqrt{Ip1^2 \times \frac{\tau}{T} + a^2 \times (1 - \frac{\tau}{T})} \leq$ Irms max

Model	Irms max
HWS1800T-6	177.5A
HWS1800T-7	142.0A
HWS1800T-12	88.7A
HWS1800T-15	71.0A
HWS1800T-24	62.1A
HWS1800T-36	41.4A
HWS1800T-48	31.0A
HWS1800T-60	24.8A

Ip, Ip1 : Peak output current(A)
Iav : Rated output current(A)
Im : Average output current(A)
τ : Peak current pulse width(sec)
T : cycle(sec)

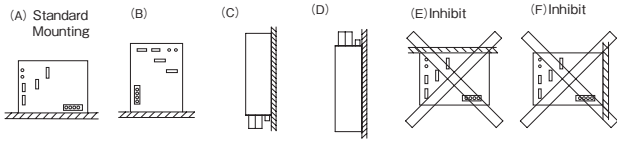
16 Input Open Phase Detection

If one of the 3-phase input line becomes open or one phase voltage falls below 160VAC, the output will be shut off in approximately 3 seconds. To restore the output to normal, shut off the input once, and apply a normal input line voltage again after for a while.

3. Mounting Directions

1 Output Derating

Mounting directions are as follows.
Standard mounting method is (A). Methods (B), (C) and (D) are also possible.
Mounting methods besides (A),(B),(C) and (D) (example : (E) and (F)) are inhibit.

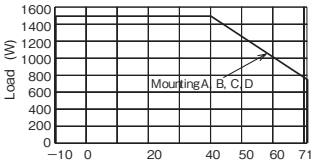


HWS1800T 3V Output Derating

Ta (℃)	LOAD (W)			
	A	B	C	D
−10 − +40	990	990	990	990
50	825	825	825	825
60	660	660	660	660
71	495	495	495	495

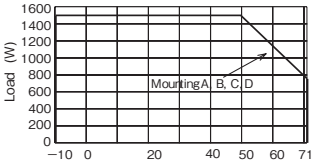
HWS1800T 5V Output Derating

Ta (℃)	LOAD (W)			
	A	B	C	D
−10 − +40	1500	1500	1500	1500
50	1250	1250	1250	1250
60	1000	1000	1000	1000
71	750	750	750	750



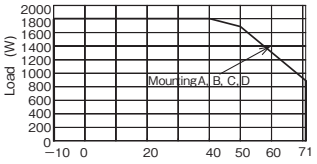
HWS1800T 6V-15V Output Derating

Ta (℃)	LOAD (W)			
	A	B	C	D
−10 − +40	1500	1500	1500	1500
50	1500	1500	1500	1500
60	1125	1125	1125	1125
71	750	750	750	750



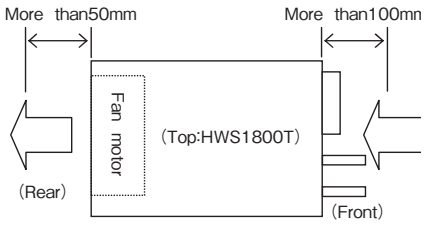
HWS1800T 24V-60V Output Derating

Ta (℃)	LOAD (W)			
	A	B	C	D
−10 − +40	1800	1800	1800	1800
50	1680	1680	1680	1680
60	1300	1300	1300	1300
71	900	900	900	900



2 Mounting Method Caution

(1) This Power supply unit is a forced air-cooling system with a built-in fan.
(2) This power supply has ventilating holes on the front and back panels.
Keep these areas freely more than 100mm from front side and more than 50mm from rear side.
(3) Please note that ventilation will be worsened in a dusty environment.
(4) Built-in fan is limited life part, which require periodic replacement. (Replacement will be charge).
(5) The ambient temperature of this power supply is less than 50mm from the center of a front side.
(6) The maximum allowable penetration of mounting screw is 6mm.
(7) Recommended torque for mounting screw (M4) is 1.27N・m.

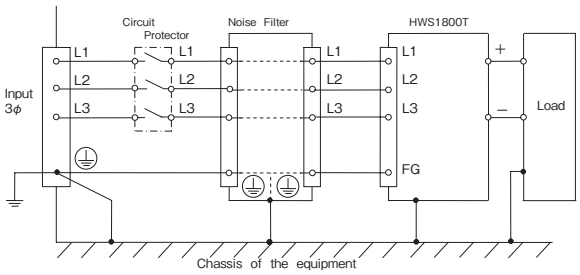


4. Wiring Method

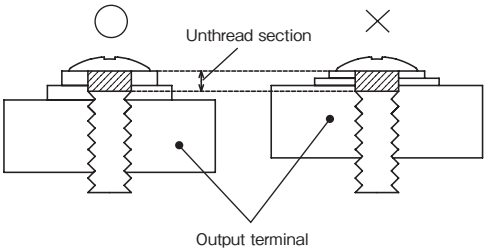
(1) The output load line and input line shall be separated and twisted to improve noise sensitivity.
(2) The sensing lines shall be twisted or shield wire and separated from the output lines.
(3) Use all lines as thick and short as possible to make lower impedance. Wires are to be twisted or use shield wire to improve noise sensitivity.
(4) Attaching a capacitor to the load terminals can eliminate noise.
(5) FG terminal of this power supply is functional earthing. For safety purposes, connect protective earthing terminal to the mounting set ground terminal.
(6) Recommended torque for the terminal piece:

Input terminal (M4 screw) : 1.27 N·m
Output terminal (M8 Bolt & Nut) : 10.8N・m

(7) Recommended wiring



(8) M4 screw for output terminal might damage the terminal's inner thread. This is mainly cause by the M4 screw's unthread section. Therefore, please select a washer, spring washer, etc. to avoid unthread screw section from penetrating into output terminal inner section.



5. External Fuse Rating

Refer to the following fuse rating when selecting the external fuses for input line. Surge current flows when line turns on. Use slow-blow fuse or time-lug fuse. Do not use fast-blow fuse. Fuse rating is specified by in-rush current value at line turn-on. Do not select the fuse according to input current (rms.) values under the actual load condition.

HWS1800T : 20A

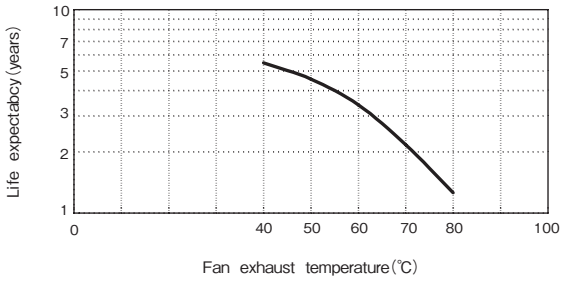
6. Troubleshooting

Before concluding that the unit is at fault, make the following checks.

(1) Check if the rated input voltage is apply.
(2) Check if the wiring of input and output is correct.
(3) Check if the I/O terminal connection is properly tighten by a regulated tightening torque.
(4) Check if the wire material is not too thin.
(5) Check if the output voltage control (V.ADJ) is properly adjusted. OVP might be trigged and output is cut off.
(6) Check if the wiring of "+S" and "-S" terminal is correct. If in open condition, the stability and the accuracy of the output deteriorate.
(7) If use function of the remote ON/OFF control, check if the remote ON/OFF control connector is not opened. If in open condition, output is cut off.
(8) Check if the built-in fan is not stopped. Is fan stopped by something irregulars or dust, etc.
If fan stops, the PF signal is turn on.
Moreover, the output is intercepted with the protection circuit if fan stops.
Fans are the limited life parts.
(9) This power supply has ventilating holes on the front and back panels. Check if there is any irregulars or dust, etc.
(10) Is the main body of the power supply abnormally hot? Please turn on the input again after allowing the unit to cool down sufficiently. The output shut down by over temperature protection function.
(11) Check if the output current and output power is not applied over specification.
(12) Check if the input voltage wave is sinusoidal. If this power supply unit is connected to a UPS, input voltage wave might not be sinusoidal. An audible noise is emmited from the power supply unit.
(13) Audible noise can be heard during Dynamic-Load operation.

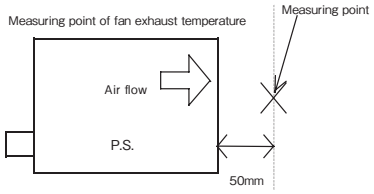
7. Warranty

This product is warranted for a period of 5 years from the date of shipment. As for the breakdown under a normal use during free warrantee term, repair is at free of charge. However, the Built-in Fan Motor replacement is for a fee. Please contact your nearest sales office for replacement.
The Fan-life has limitation. Therefore, periodic maintenance by replacing the life-expired fan is required.
The following figure shows the life of fan.



Life expectancy

Fan exhaust temperature	45℃	45,000 hour
Fan exhaust temperature	80℃	11,000 hour

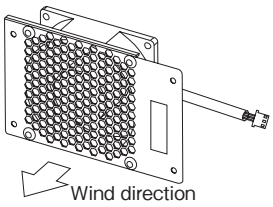


Please read the General Safety Instruction before using the products.

8. Option

1 Fan unit for replacement

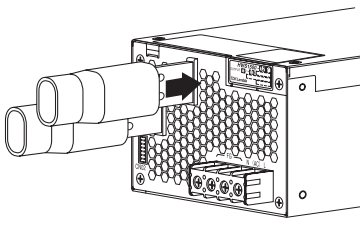
We have prepared an optional fan unit for replacement.

Name of fan unit for replacement	Applicable models	Appearance	Pin assignments	Price
1500-FAN-01	HWS1000 HWS1500 HWS1800T (of standard specifications)		Housing = XHP-3(J.S.T.) Contact = SXH-001T-P0.6(J.S.T.) Pin No. / Description 1 Power supply 2 Fan alarm 3 GND Length of fan harness = 65 ± 10mm	Open

Ask us for replacement of the fan. This will be a charged service. If you are replacing the fan by yourself, note the following.
*1. Be careful in handling the fan unit so as not to cause an impact by dropping it or hitting it, etc.
*2. Shut down the input before starting the replacement operation.
*3. Check that there are no loose parts in connectors or harness tucking, etc.
*4. Safety standards (UL, CE, etc.) are not applicable.

2 Insulation tube for HWS1800T

The following insulation tube can becuse for output terminal.
・TCV-2001 (shinagawa shoko)
Please confirm shape and size from manufacturer catalog.



Example of use for insulation tube

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