

OPERATOR'S MANUAL

HSF-A 1500W SERIES POWER SUPPLY

SINGLE OUTPUT POWER SUPPLIES
SINGLE PHASE, UNIVERSAL AC INPUT, OPTIONAL METER

KEPCO INC.
An ISO 9001 Company.



MODEL HSF-A 1500W SERIES POWER SUPPLY

HSF 15-100A (C) (M), HSF 24-50A (M),
HSF 36-42A (M), HSF 48-32A (M),
HSF 60-25A (M)

IMPORTANT NOTES:

- 1) This manual is valid for the following Model and associated serial numbers:

MODEL	SERIAL NO.	REV. NO.
HSF-A, 1500W		

- 2) A Change Page may be included at the end of the manual. All applicable changes and revision number changes are documented with reference to the equipment serial numbers. Before using this Instruction Manual, check your equipment serial number to identify your model. If in doubt, contact your nearest Kepco Representative, or the Kepco Documentation Office in New York, (718) 461-7000, requesting the correct revision for your particular model and serial number.
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1. INTRODUCTION

1.1 SCOPE OF MANUAL

This Operator's Manual covers the installation and operation of the Kepco HSF-A 1500W Series of Switching Power Supplies. For service information, write directly to: Kepco Inc., 131-38 Sanford Avenue, Flushing, New York, 11355, U.S.A. Please state Model Designation and Serial Number of your HSF Power Supply (see nameplate of the unit).

1.2 DESCRIPTION

The Kepco HSF-A 1500 Watt Series are hot swappable, plug-in power supplies. Metered models (M suffix) are completely interchangeable with the non-metered HSF-A 1500W Series. Four models may be selected for outputs of 15V, 24V, 36V, 48V or 60V. They employ forward conversion and power factor correction and are designed to operate in a fault tolerant power system with a nominal a-c input of 100V a-c to 240V a-c (input voltage range 90 to 265V a-c), 50-60Hz (input frequency range 47-63Hz). A built-in current balancing circuit and OR-ing diodes allow configuration for hot-swap and parallel-redundant N+1 operation.

These power supplies are designed to be used with Kepco's Series RA 19-4C rack adapters. The RA 19-4C rack adapter accepts up to four modules. All input/output connections are through a 24-pin connector that plugs in to the rack adapter. All external connections are made through the rack adapter's I/O connector (see Figure 1).

An optional meter (M suffix) provides digital indication of voltage or current (switch selectable) from the front panel. RoHS-compliant models indicated by HSF* (e.g., HSF 24*50AM).

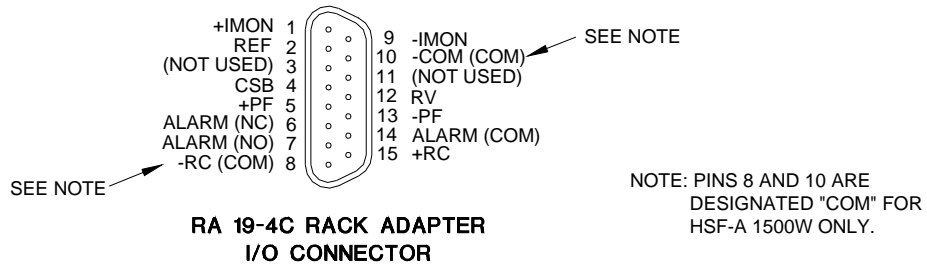


FIGURE 1. RA 19-4C RACK ADAPTER I/O CONNECTOR

TABLE 1. REAR CONNECTOR PIN ASSIGNMENTS

Signal Name	Pin	Function
Output +	1, 2, 4	DC output (+) applied to load.
Output -	3, 5, 6	DC Output (-) applied to load.
S-	7	-Sense connection
IMON+	8	Current Monitor+ (used on C and M suffix only).
S+	9	+Sense connection
NO	10	Normally Open contact of alarm relay, referenced to AL COM, pin 14 (see PAR. 3.8.2).
IMON-	11	Current Monitor- (used on C and M suffix only).
COM	12	Signal Common - return for AUX 5V pin 15, RV pin 18 and CSB pin 17.
NC	13	Normally Closed contact of alarm relay, referenced to AL COM, pin 14 (see PAR. 3.8.2).
AL COM	14	Common contact of alarm relay (see PAR. 3.8.2).
AUX 5V	15	+5V supply for optional I ² C communication when enabled by DIP switch SW1 position 1 Return is COM (pin 12, 19, or 21) Caution: Not short circuit protected!
+PF	16	+Power Fail of open-collector alarm circuit. Used with COM, pin 19 (see PAR. 3.8.2).
CSB	17	Current Share Bus - Used whenever several power supplies are connected in parallel (see PAR. 5.).
RV	18	Remote Voltage - Return is COM (pin 12, 19, or 21) Used for remotely controlling the output voltage (see PAR. 3.4.2)

TABLE 1. REAR CONNECTOR PIN ASSIGNMENTS (CONTINUED)

Signal Name	Pin	Function
COM	19	Signal Common - return for AUX 5V pin 15, RV pin 18 and CSB pin 17.
+RC	20	+Remote On-off used with -RC, pin 21, to allow remote turn-on turn-off of the unit (see PAR. 3.6)
COM	21	Signal Common - return for AUX 5V pin 15, RV pin 18 and CSB pin 17.
GND	22	AC input ground
N	23	AC Input neutral
L	24	AC input line

2. SPECIFICATIONS

Table 2 contains specifications and operating limits of individual HSF-A 1500W Series models. Table 3 contains specifications and operating limits common to all HSF-A 1500W Series Models. These specifications are at nominal input voltages at 25°C and apply to all models unless otherwise specified.

TABLE 2. OUTPUT RATINGS AND SPECIFICATIONS

MODEL		HSF 15-100A	HSF 24-50A	HSF 36-42A	HSF 48-32A	HSF 60-25A
Output Volts d-c (nominal)		15	24	36	48	60
Adjustment Range (Volts)	Front panel Trimpot	0 - 15.2 (0 - 16.6 ⁽⁴⁾)	0 - 30.5	0 - 36.8	0 to 49.4	0 to 62
Maximum Output Current and Power Ratings ⁽¹⁾ (A,W)	90-100V a-c Input	90 - 100				
	100 - 264V a-c Input:	105	105			
Overvoltage Protection Level ⁽²⁾ Variable OVP (% of VSET)	at output terminals	115% ±9%	120% ±7%			
Current Limit Setting (Amps)	100 - 264V a-c Input:	105	52.5	43.7	32.8	26.2
Efficiency (%)	Typical	86	89	89	90	91
Ripple & Noise ⁽³⁾ (mV, p-p)	maximum	180	300	360	480	600
Sense Resistor (I _{Mon}) values (Ohms)	Metered models only	0.001	0.002	0.002	0.005	0.005

- (1) See Figure 3 for power derating vs. temperature and input voltage.
- (2) Protection type: Latch-style (recovery after reset AC power ON or inhibit)
- (3) Ripple & noise measured at 20MHz bandwidth using 12" twisted pair wire terminated with 1 uF ceramic capacitor.
- (4) 16.6V at no load allows application with load wire voltage drop >0.75V per output wire. Load regulation will exceed published values (remote sense wire max compensation of 1V exceeded). May trigger OVP if local sense lines are enabled or load wire compensation is within rated 0.5V drop per output wire. If OVP occurs, adjust output to 15.2V max.

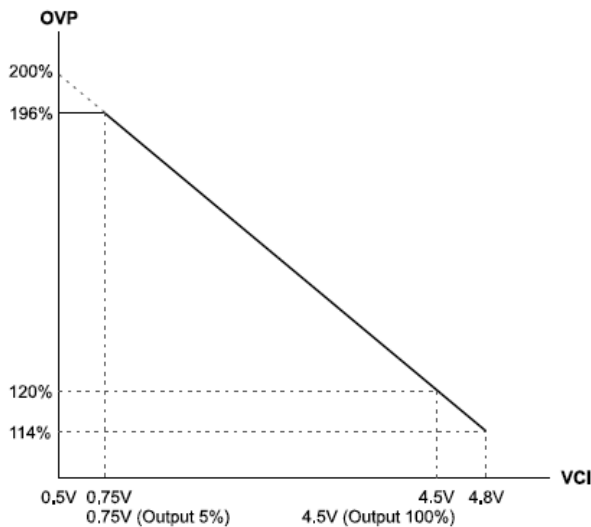


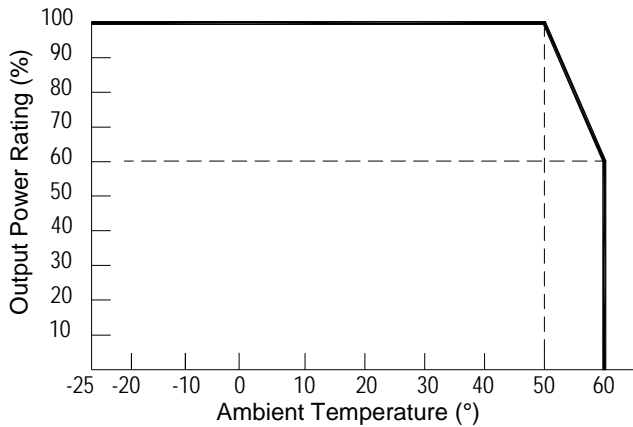
FIGURE 2. VSET (VCI) VS OVP CURVE

TABLE 3. POWER SUPPLY RATINGS AND SPECIFICATIONS

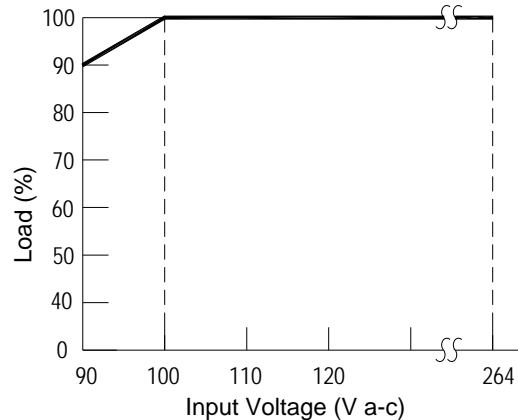
CHARACTERISTIC	SPECIFICATION	CONDITION/NOTES
Input Voltage	Range: 90-264V a-c, 127-370V d-c	Up to t0% derating between 90 and 100V a-c
Input Source Frequency	Range: 47-63 Hz	
Input Current:	115V a-c 18A 230V a-c 9A	Maximum Load At 25°C with Nominal Output Voltage
Input Protection	The internal power supply is protected against shorts by an input fuse.	
Input Surge cold start, inrush current	115V a-c 30A 230V a-c 40A	Maximum Load At 25°C with Nominal Output Voltage
Leakage Current:	<2.5mA	240V a-c
Power Factor,	115V a-c 0.99 230V a-c 0.95	
Voltage Stabilization		
Source Effect	±1%	
Load Effect	±1% (±1% typ., ±4% max for 15V model)	
Temperature Effect	±0.02% / °C	
Combined Effect	±1.6% typical, ±3.2% maximum	Source, Load and Temperature
Start-up Time	800 msec (860 msec for 15V model)	
Output Hold-up Time	14 msec	230V a-c at full load
Protection		
Overvoltage	Variable OVP, 120% ± 7% (115% ±9% for 15V model), refer to VSET vs OVP curve Figure 2. Protection type: Latch style, recovery after AC power cycle or inhibit	
Overload	24V to 60V models: 105% rated output power 15V models: 101% rated output power Protection type: constant current limit:	
Overtemperature	85 ± 5°C detected on NTC Auto recovery after temperature goes down	
Auxiliary Power	Selectable +5V / 0.5A or +9V / 0.1A auxiliary output	
Remote ON/OFF Control	By external switch	
Power OK signal	Open drain signal low when PSU turns on, Max. sink current 20mA, Max. drain voltage: 40V.	
Parallel Current Share	When connected In parallel, only one unit will operate if the total output load is less than 5% of the rated power.	
Meter (M suffix only) displays voltage or current; front panel switch-selectable	Voltmeter Accuracy: ±3% Ammeter Accuracy: ±5% for loads between 10%-100%	Voltmeter reads voltage at test points (will differ from voltage at load depending on load cable length). Ammeter accuracy degrades significantly for loads less than 10%

TABLE 3. POWER SUPPLY RATINGS AND SPECIFICATIONS (CONTINUED)

CHARACTERISTIC	SPECIFICATION	CONDITION/NOTES
Temperature	Operating: -25 to +60°C Storage: -40 to +85°C	Refer to power rating curve, Figure 3.
Humidity	Operating: 20 -90% RH Storage: 10 to 95% RH	non-condensing
Vibration	10 -500Hz, 2G 10min./1cyc1e, period for 60min. each along X, Y, Z axes	Compliance to IEC 68-2-6, IEC 68-2-84
Safety Standards	Certified UL 60950-1; EN 60950-1	15V model: Designed to meet.
Withstand Voltage, input to output input to ground output to ground	3KV a-c (4,242V d-c)	
	1.5KV a-c (2,121V d-c)	
	0.5KV a-c (707V d-c)	
Isolation Resistance, input to output input to ground output to ground	100M Ohms 1500V d-c	
	100M Ohms 1500V d-c	
	100M Ohms 1500V d-c	
EMI Conduction and Radiation	Certified EN 55022; EN 61204-3; EN 61000-6-3	
Harmonic Current	Certified EN 81Q00.3.2; EN 61Q00.3.3	
EMS Immunity	Certified EN 55024; EN6 1204-3; EN6 1000-6-1; IEC 61000-4-2, 3, 4, 5, 6, 8,11	
Mounting:	Plug-in	
Cooling:	Forced air flow - load/temperature controlled fan	
Dimensions	5.22 in. (132.5 mm) x 4.288 in. (108.9 mm) x 16.86 in. (428.2 mm) (See Figure 4)	
Weight	8.42 lbs (3.82 kg)	15V model: 9.0 lbs (4.08 kg)



POWER RATING VS. TEMPERATURE



LOAD VS. INPUT VOLTAGE

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FIGURE 3. POWER RATING VS. TEMPERATURE, LOAD VS. INPUT VOLTAGE

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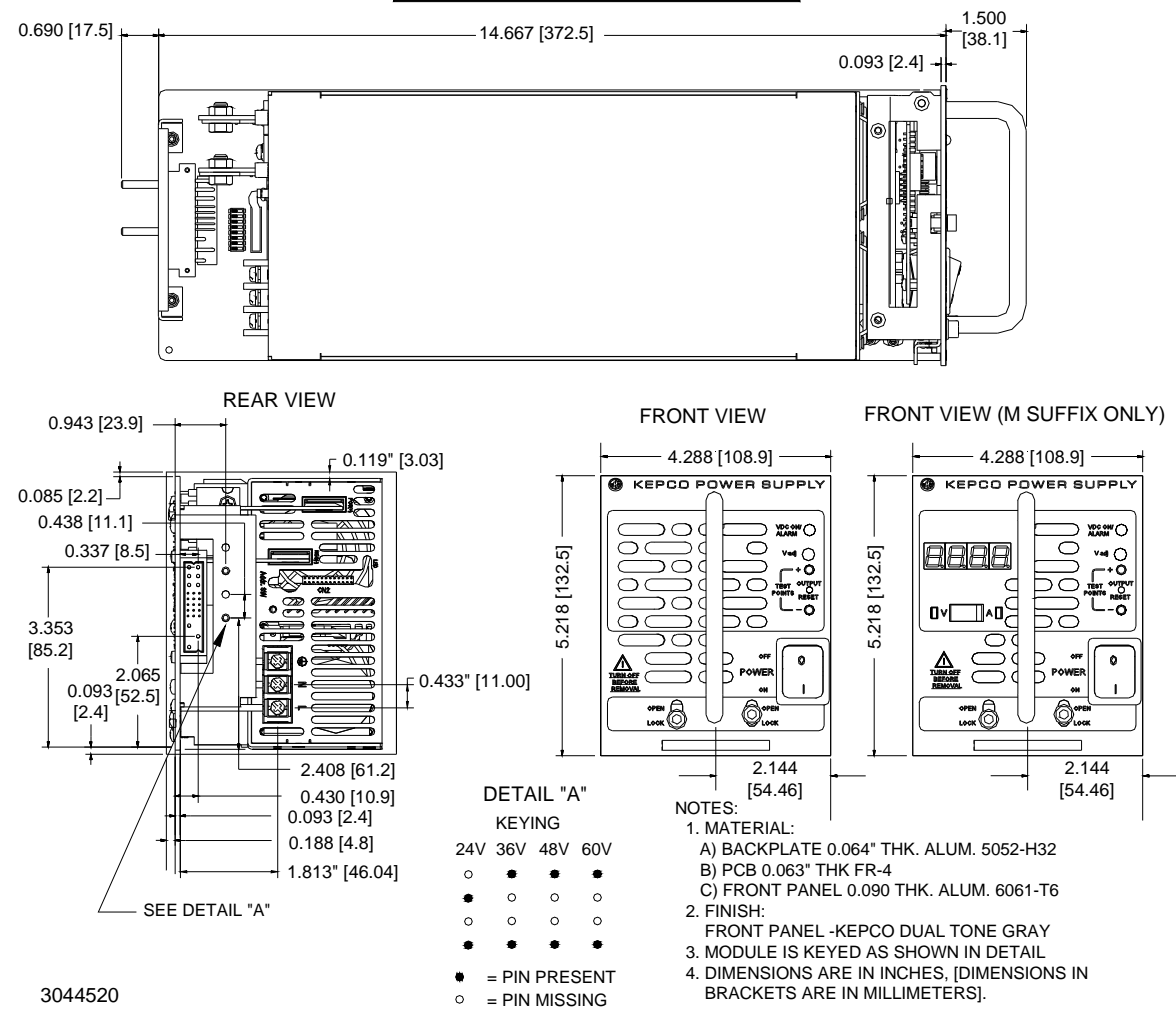


FIGURE 4. MECHANICAL OUTLINE DRAWING OF HSF 1500W POWER SUPPLY

3. FEATURES

3.1 DIP SWITCH CONFIGURATION

The power supply incorporates one DIP switch, SW1 (see Figure 5), which must be configured before the unit is installed in the rack adapter. The DIP switches control the following parameters:

- Position 1 - default: position 1 is OFF. When switch is ON, AUX 5V supply is made available on pin 15 (used for I²C communication).
- Positions 2 and 3 - default position 2 is OFF, position 3 is ON, allows output voltage setting by front panel Vadj control (see PAR. 3.4.1).

When position 2 is ON and position 3 is OFF, front panel Vadj control is disabled and allows HSF output voltage setting by either an external trimpot or voltage source (see PAR. 3.4.2)

- Positions 4 and 5 - default position 4 is OFF, position 5 is ON - allows HSF output to be reset after a fault using the front panel OUTPUT RESET switch and disables remote ON/OFF control of HSF output. (see PAR. 3.6)

When position 4 is ON and position 5 is OFF, allows HSF output to be enabled/disabled via mechanical switch or logic level (see PAR. 3.6); front panel OUTPUT RESET switch is disabled.

- Positions 6 and 7 - default position 6 is OFF, position 7 is ON - allows alarm signals to be produced from internal relay, Form C contacts (one NO, one NC) (see PAR. 3.8.2).

When position 6 is ON, connects +PF on RA 19-4C I/O connector to the internal not-isolated alarm signal

- Position 8 - default position is ON - allows red LED front panel ALARM indicator to function (see PAR. 3.8.1). When switch is OFF, the front panel red ALARM indicator is disabled.

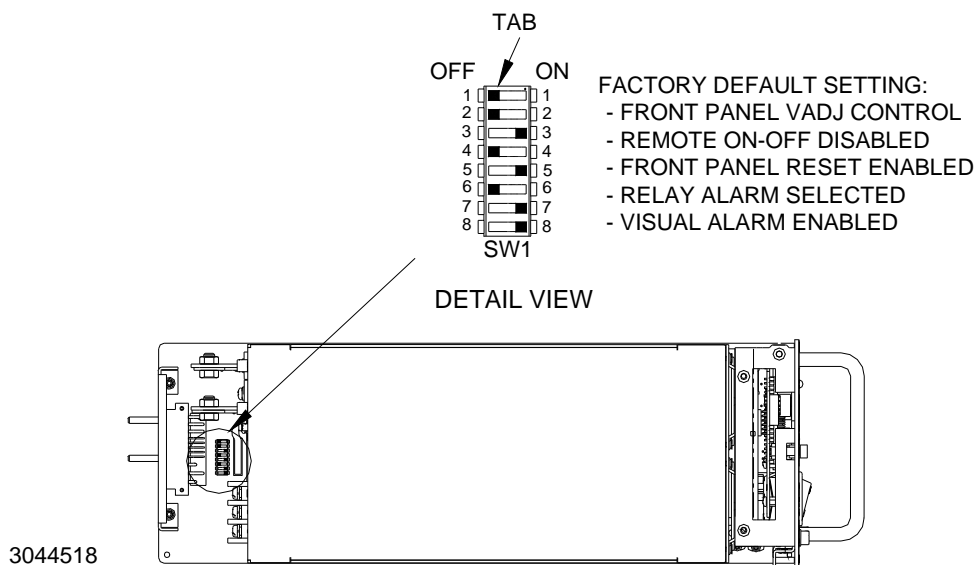


FIGURE 5. DIP SWITCH CONFIGURATION

3.2 FRONT PANEL ACCESS.

The front panel provides a power ON/OFF switch controlling input power and a “VDC ON” indicator which lights green when the unit is operating. The indicator lights red if the unit fails or if RESET is pressed; it lights red for about 30 seconds if there is a power loss..

CAUTION: DO NOT repeatedly toggle the power ON/OFF switch as this may cause unit to fault.

NOTE: The ON/OFF switch must be set to OFF before installing or removing unit from rack adapter.

If remote on-off is not enabled (see PAR. 3.6), the OUTPUT RESET button restores output power in the event that overcurrent or overvoltage protection has tripped, or thermal overload or fan malfunction has occurred.

If remote voltage control (see PAR. 3.4.2) is not enabled, the front panel Vadj trimmer (see PAR. 3.4.1) provides adjustment of the output voltage within the limits specified in Table 1; test points are available at the front panel for monitoring the DC output.

Figure 3.4 shows the location of all operating controls, indicators and test points followed by an explanation of each.

3.3 KEYING

Keying of the power supply is established at the factory. The output voltage determines which key pins are installed (see Figure 4, Detail A). When the proper holes in the rack adapter are blocked by keying screws installed by the user, only a power supply of the correct voltage can be inserted in the rack adapter slot. Refer to the RA 19-4C Manual for rack adapter keying instructions.

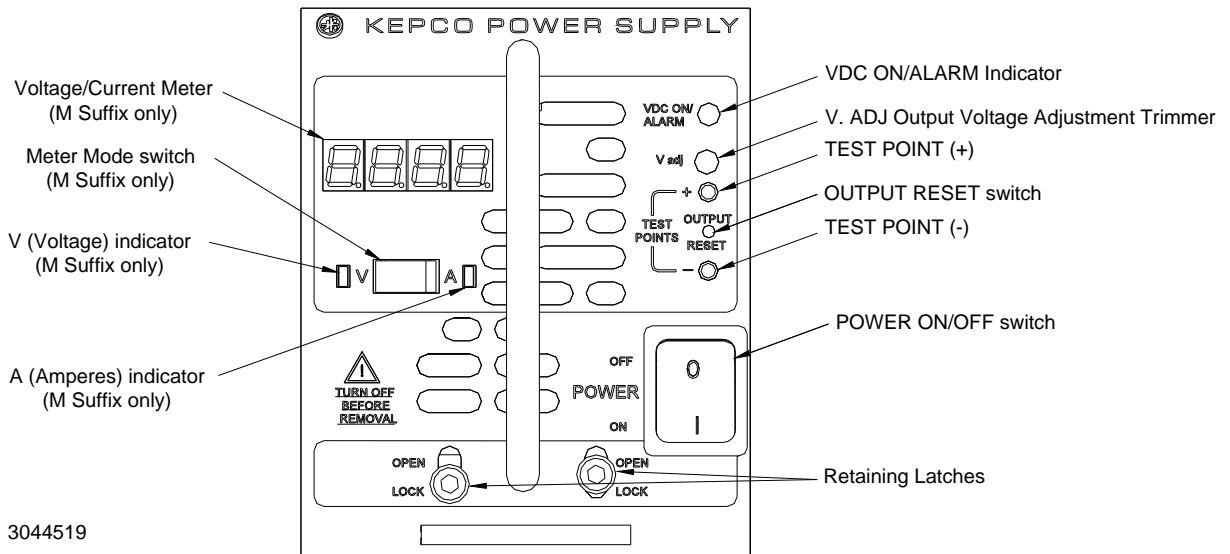


FIGURE 6. FRONT PANEL CONTROLS, INDICATORS AND TEST POINTS

- VDC ON/ALARM indicator. Lights green when unit is operating. When enabled by DIP switch configuration, lights red to indicate loss of output voltage (see PAR. 3.8.1).
- V.ADJ Output voltage adjustment trimmer: Adjusts output voltage within limits specified in Table 2 (see PAR. 3.4.1). Not functional if remote voltage control is enabled (see PAR. 3.4.2).
- DC output test points (+, -): Connect to voltmeter to monitor output voltage.
- OUTPUT RESET switch. Used to recycle power in the event of an alarm condition (see PAR. 3.7). Not functional when remote on/off control is enabled (see PAR. 3.6).
- POWER ON/OFF rocker switch. Applies power to the unit.
CAUTION: Power must be OFF before unit is installed or removed from the rack adapter.
- Retaining Latches (2). Prevents inadvertent removal of unit from rack adapter (see PAR. 3.9)
- (M Suffix only) Voltage/Current meter: Monitors output voltage or current according to setting of Meter Mode switch.
- (M Suffix only) Meter Mode switch: Set to V for display to show output voltage, set to A to show output current.
- (M Suffix only) V indicator: Lights green to indicate meter is showing Volts.
- (M Suffix only) A indicator: Lights amber to indicate meter is showing Amperes.

3.4 OUTPUT VOLTAGE CONTROL

Output Voltage can be controlled from either the front panel (PAR. 3.4.1) or externally using a trimpot or voltage source (PAR. 3.4.2).

3.4.1 FRONT PANEL VOLTAGE CONTROL

Output voltage can be manually adjusted with the voltage adjustment control, V_{adj} (see Figure 6 for location) when DIP switch SW1 position 3 is set to ON and position 4 is set to OFF shown in Figure 5 (factory default) To adjust voltage, first place the unit under an operating load. Then monitor the (+) and (-) test points on the front panel with a precision voltmeter and turn the voltage control to the desired operating value.

3.4.2 REMOTE VOLTAGE CONTROL

For remote voltage control, set position 2 of the DIP switch to ON and position 3 to OFF (see Figure 5 for switch location). This removes control from the front panel V_{adj} control and allows the output voltage to be adjusted by either an external trimmer pot (resistance) or by an external variable voltage source connected across the rack adapter I/O connector pin 12 (RV, Remote Voltage) and pin 10 (COM, Common) as shown in Figure 7. At the rack adapter I/O connector use a shielded wire 6.6 feet (2M) maximum in length, for connection of RV (pin 12), and COM (pin 10) to the trimmer control or external voltage source.

NOTE: If remote voltage control is not implemented, the factory default for DIP switch positions 2 and 3 must be restored (Figure 5).

It is possible that the overvoltage protection may be triggered if the output voltage is decreased to a low level very quickly when the power supply is at a low load condition.

RESISTANCE: Connect a 0 to 5kohm variable resistor as shown in Figure 7A to adjust the output voltage from zero to nominal. The 1mA current source inside the unit provides polarization to RV, allowing RV voltage to be adjusted from zero to 5V.

VOLTAGE. By adjusting an external 0 to 5V voltage source capable of absorbing current of 1mA or more, the output voltage can be adjusted from 0 to 100% of nominal. Connect the voltage source across the RV and COM pins as shown in Figure 7B.

3.5 CURRENT MONITOR (M, C SUFFIXES ONLY)

Current monitor is via \pm IMON assigned to HSF I/O connector pins 8 and 11, connected to pins 1 and 9 of the RA 19-4C I/O connector (see Figure 1). Monitored Output Current (Amps) = Voltage drop across R_s (Volts) \times R_s (Ohms), where voltage drop across R_s (see Table 2) is measured across \pm IMON pins (requires millivoltmeter, range 0 to 200mV). Accuracy is $\pm 1\%$. There is no isolation between \pm IMON and d-c output.

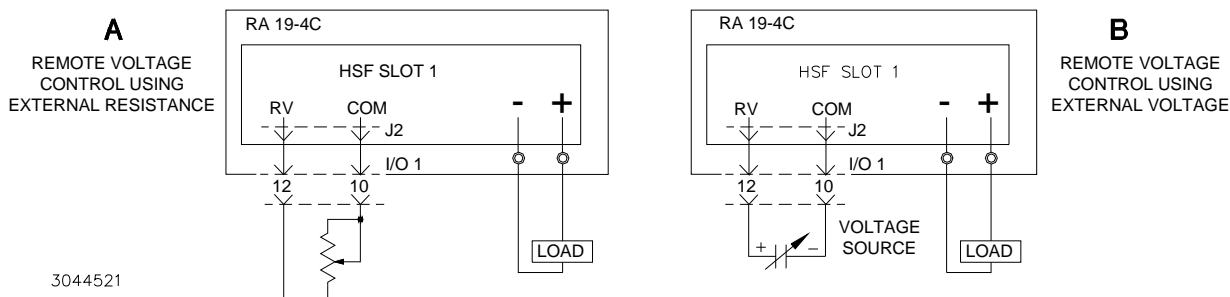


FIGURE 7. CONNECTIONS FOR REMOTE VOLTAGE CONTROL

3.6 REMOTE ON-OFF

When power is ON at the source, the output may be turned ON or OFF using the +RC signal if the remote ON-OFF feature is enabled. Note that when remote ON-OFF is enabled, the RESET OUTPUT switch does not function. The unit can be reset using the remote ON-OFF feature or by leaving the unit OFF for at least 40 seconds

Remote ON-OFF is enabled by setting DIP switch position 4 to ON and position 5 to OFF. The +RC signal, referenced to COM (at the rack adapter I/O connector, pins 15 and 10, respectively) then turn the unit on or off. These pins accept a logic level (3.3 to 5V "high" and 0.0 to 0.4V "low"), or a contact closure. When +RC to COM is open using a high level logic signal, the power supply output is cut OFF. When +RC is shorted to COM, the output returns to within specifications. Positions 4 and 5 of the DIP switch must be restored to the factory default setting (Figure 5) if remote ON-OFF is not used. The +RC pin is not isolated from the negative DC output pin.

3.7 PROTECTION CIRCUITS

The following protection features are implemented in the power supplies: overvoltage and over-temperature (PAR. 3.7.1), current limit/excess power (PAR. 3.7.2) and fan failure (PAR. 3.7.3). The power supply provides a configurable visual alarm (see PAR. 3.8.1) as well as an option to use either relay contacts or logic levels for alarm signals (see PAR. 3.8.2)

3.7.1 OVERVOLTAGE AND OVERTEMPERATURE PROTECTION

When the output voltage of the power supply increases beyond the specified values (see Table 2), the output is cut OFF and the fan turns OFF. To restart (reset) the unit, press and release the OUTPUT RESET switch on the front panel or use the remote on/off feature (see PAR. 3.6). The unit may also be restarted by turning the POWER ON/OFF switch to OFF, waiting at least 40 seconds, then setting the POWER switch to ON.

When the internal temperature of the power supply increases beyond safe values, the output is cut OFF and the fans turn OFF. The restart cycle (Power ON) should not begin until the temperature returns to within specifications. To restart (reset) the unit, set the POWER ON/OFF switch to OFF, wait 40 seconds, then set the POWER switch to ON. The power supply cannot be reset using the remote ON-OFF feature unless the power supply remains shut down for at least 40 seconds.

3.7.2 CURRENT LIMIT SETTING AND EXCESS POWER PROTECTION

The output characteristic of the power supply is square type, with default current limit at 105% of nominal current.

If a current limit lower than the default is needed, a 0.5 to 4.5 kohm resistor can be installed on the main printed circuit board at location R9. A resistor of 1 kohms limits the current to about 20%, 2.5 kohms to about 50%, 4 kohms to about 80% of the unit's nominal current.

In the rare case when both the output voltage and current are above their nominal values, excess power protection may shut down the unit. This happens when the internal power module power level exceeds 105% (101% for 15V model) of nominal power (1515W for the 15V model, 1530W for the 24V model or 1550W for the 36, 48, 60V models).

To restart (reset) the unit, press and release the OUTPUT RESET switch on the front panel or use the remote on/off feature (see PAR. 3.6). The unit may also be restarted by turning the POWER ON/OFF switch to OFF, waiting 40 seconds, then setting the POWER switch to ON.

3.7.3 FAN FAILURE

A fan failure causes the output to shut down and the fans to turn OFF. Fan failure and all the other protection circuit operations produce an alarm (see PAR. 3.8.2). To restart (reset) the unit, press and release the OUTPUT RESET switch on the front panel or use the remote on/off feature (see PAR. 3.6). The unit may also be restarted by turning the POWER ON/OFF switch to OFF, waiting 40 seconds, then setting the POWER switch to ON. If fan rotation is out of specification the power supply will not recover.

3.8 ALARM SETTINGS

3.8.1 VISUAL ALARM.

The front panel VDC ON/ALARM indicator can be configured to light red if a) the respective power supply output voltage is lost, b) the unit is reset (local or remotely) or c) if the POWER switch is set to OFF (indicator lights red for 30 seconds after setting to OFF). This feature is enabled when DIP switch 1, position 8 set to ON (factory default, see Figure 5 for switch location).

3.8.2 ALARM SIGNALS.

Either of two options are available for signalling alarms: isolated relay contacts (factory default, PAR. 3.8.2.1) or logic level alarm signals +PF (PAR. 3.8.2.2).

3.8.2.1 INTERNAL ISOLATED RELAY ALARM

The first option, the factory default setting, uses an isolated internal relay offering normally closed (NC) and normally open (NO) contacts referenced to an isolated common (AL COM). These contacts may be used to configure “close on failure” or “open on failure” alarm circuits. (Refer to the Series RA 19-4C Manual for alarm configurations for multiple HSF power supplies.) Setting position 6 to OFF and 7 to ON (factory default) selects this option. The NC (pin 6 of the rack adapter I/O connector) and NO (pin 7) signals are referenced to Alarm common (pin 14).

3.8.2.2 OPTICALLY-COUPLED LOGICAL ALARM

This \pm PF signals, available in older non-A suffix HSF 1200/1500W models are not available in the HSF-A 1500W series. Therefore DIP switch SW1 position 6 should always be set to OFF and position 7 set to ON.

3.9 RETAINING LATCHES

HSF-A 1500W series power supplies are provided with (2) retention latches located at each side of the bottom edge of the front panel (see Figure 6). These latches work in conjunction with the RA 19-4C rack adapters to prevent unauthorized or inadvertent module extraction from an operating power system. The latch is engaged by loosening the cap-head screw approximately 1/2 turn CCW (use 5/32” hex key) and sliding the latch down to the bottom of the slot, then retightening the cap-head screw CW until snug. DO NOT OVERTIGHTEN! To release, follow the same procedure, except lift the latch to the top of the slot. Be sure to move the latch completely up or down to ensure full engagement and disengagement of the latching mechanism. When the HSF-A power supply is not installed in its plug-in rack adapter, it is recommended that the latch be secured in the open (up) position to prevent damage.

NOTE: Retaining latches must *not* be used to secure the HSF power supply in the rack adapter for shipping purposes. For shipping HSF units installed in the rack adapter, the units must be secured by two flat head #8 screws (Kepco P/N 101-0188): FLP0, 8-32 X 0.375, ST at the top of the rack adapter.

4. LOAD CONNECTION

Connect the load to (+) and (-) terminals at the rear panel of the Rack Adapter. See Figure 8 for the proper way to connect multiple loads.

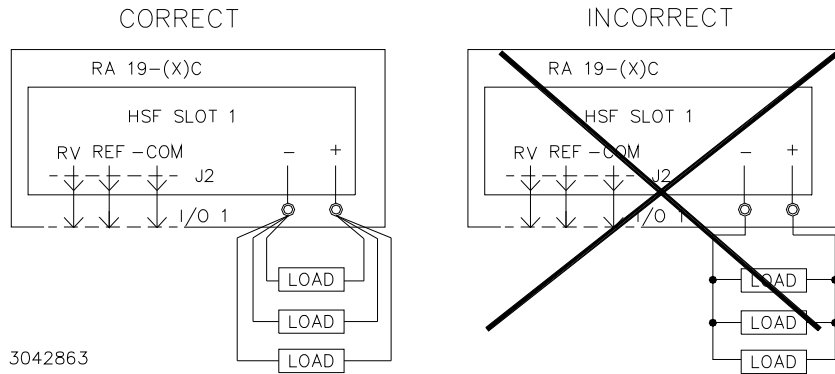


FIGURE 8. CORRECT AND INCORRECT METHODS OF LOAD CONNECTION

5. CONNECTING MULTIPLE POWER SUPPLIES

All connections to multiple HSF-A power supplies must be made via the I/O mating connectors at rear of the Rack Adapter and/or by the Rack Adapter DIP switches. These connections, including the configuration of the internal HSF DIP switch, are described in the Rack Adapter Instruction manual, and include:

- Using parallel configurations (for increased current or redundancy)
- Using series configurations (for increased voltage).
- Using open-on-fail or close-on-fail alarm schemes with multiple power supplies.

