

# OPERATOR'S MANUAL

## HSF A, (M) (Z) 600 WATTS POWER SUPPLY

SINGLE OUTPUT POWER SUPPLIES  
SINGLE PHASE, POWER FACTOR CORRECTED  
UNIVERSAL AC INPUT

KEPCO INC.  
An ISO 9001 Company.

MODEL CE  
**HSF A, (M) (Z) 600 WATTS**  
**POWER SUPPLY**

HSF 12-53A, HSF 15-43A,  
HSF 24-27A, HSF 28-23A, HSF 48-13A  
HSF 12-53AM, HSF 15-43AM,  
HSF 24-27AM, HSF 28-23AM, HSF 48-13AM

### IMPORTANT NOTES:

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

MODEL	SERIAL NO.	REV. NO.
HSF A, (M) (Z) 600 Watts		

- 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 600W Series of Switching Power Supplies. Models covered by this manual include basic models, identified by the suffix "A" following the model number, and all options.

**Option M.** Models with suffix "M" include an integral voltage/current meter.

**Option Z.** Models with suffix "Z" allow adjustment down to 0V without restrictions for maintaining VDC ON indicator and alarm functionality. Models with both options, M and Z, have no restrictions on meter functionality.

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. This information can be found on the nameplate of the unit.

## 1.2 DESCRIPTION

The Kepco HSF A 600 Watt Series are hot swappable, high frequency switching, plug-in power supplies that are completely interchangeable, including options M and Z, as well as with Kepco's earlier 600 Watt HSF Series (non A). When integrating A and non A models refer to PAR's. 3.5 and 3.7.2.2 regarding isolation of the return signal of the RC and PF features. Unless otherwise noted, all data supplied herein applies to A models including those with option M and/or Z.

Five models may be selected for outputs of 12V, 15V, 24V, 28V or 48V. They employ forward conversion and power factor correction and are designed to operate in a fault tolerant power system. Input voltage range is single phase 85-265V a-c (47-63Hz) or 120-330V d-c. Input voltage which is out of specification may cause unit damage. Safety standards apply when input voltage is within 100-240V a-c (50-60Hz). A built-in current balancing circuit and OR-ing diodes allow configuration for hot-swap and parallel-redundant N+1 operation.

HSF A (without meter) and AM (with meter) Models use the HSF output to power the VDC ON indicator and internal alarm relay. A minimum HSF output voltage is needed to maintain functionality for these components. For HSF AM models a minimum output is also needed to power the meter. HSF A models with option Z do not use the output to power the VDC ON indicator, alarm and meter circuits; instead these circuits are powered by an integral auxiliary power supply, so the restrictions outlined above do not apply.

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 600W modules. All input/output connections are through a 24-pin connector that plugs in to the rack adapter. All external connections described in the following paragraphs are made through the rack adapter's I/O connector (see Figure 1).

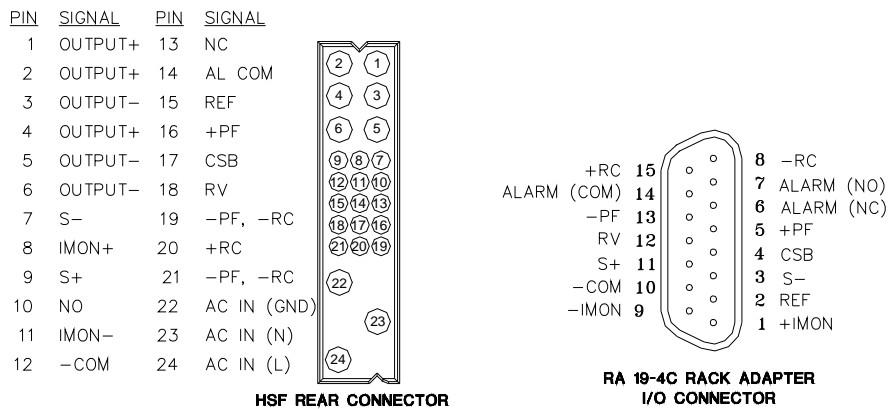


FIGURE 1. HSF A REAR PANEL CONNECTOR AND RA 19-4C RACK ADAPTER I/O CONNECTOR

**TABLE 1. HSF A REAR CONNECTOR PIN ASSIGNMENT**

Signal Name	Pin	Function
Output +	1, 2, 4	DC output (+) applied to load.
Output –	3, 5, 6	DC Output (–) applied to load.
SENSE–	7	Sense– connection.
IMON+	8	Current Monitor+ (sense resistor).
SENSE+	9	Sense+ connection.
NO	10	Normally Open contact of alarm relay, referenced to AL COM, pin 14 (see PAR. 3.7.2.1).
IMON–	11	Current Monitor– (sense resistor).
–COM	12	–Signal Common provides return for REF, pin 15, and RV, pin 18, signals.
NC	13	Normally Closed contact of alarm relay, referenced to AL COM, pin 14 (see PAR. 3.7.2.1).
AL COM	14	Common contact of alarm relay (see PAR. 3.7.2.1).
REF	15	Reference voltage. When used with RV, pin 18, allows all output voltages of paralleled slave supplies to be controlled by one voltage adjustment of a master power supply. When REF is connected to RV via an external trimmer, the external trimmer determines output voltage (see PAR. 3.4.2). Connections are made via DIP switches (see PAR. 3.1).
PF	16	Power Fail of open-collector alarm circuit. Used with pins 19, 21 (see PAR. 3.7.2.2).
CSB	17	Current Share Bus - Used whenever several power supplies are connected in parallel (see PAR. 5.).
RV	18	Remote Voltage - Used with REF, pin 15, for remotely controlling the output voltage (see PAR. 3.4.2)
RC and PF return	19	Power Fail return of open-collector alarm circuit. Used with PF, pin 16 (see PAR. 3.7.2.2). Connected in common with pin 21.
RC	20	Remote On-off used pins 19, 21, to allow remote turn-on turn-off of the unit (see PAR. 3.5)
RC and PF return	21	Remote On-off return for RC, pin 20, to allow remote turn-on turn-off of the unit (see PAR. 3.5). Connected in common with pin 19.
GND	22	AC input ground.
N	23	AC Input neutral.
L	24	AC input line.

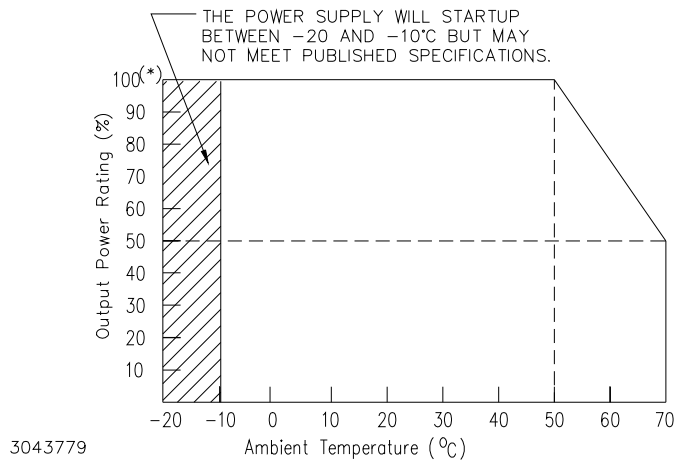
## 2. SPECIFICATIONS

Table 2 contains specifications and operating limits of individual HSF A 600W Series models. Table 3 contains specifications and operating limits common to all HSF A 600W Series Models. These specifications are at nominal input voltages at 25°C unless otherwise specified.

**TABLE 2. HSF 600W A OUTPUT RATINGS AND SPECIFICATIONS**

HSF A MODEL		12-53A, AM	15-43A, AM	24-27A, AM	28-23A, AM	48-13A, AM
Output Volts d-c (nominal)		12	15	24	28	48
Output Adjustment Range <sup>(1)</sup> (Volts d-c) <sup>(2)</sup>	SW1 pos 7 OFF (default)	4.8 to 13.8	6 to 17.4	9.6 to 28.2	9.6 to 29.0	19.2 to 52.2
	SW1 pos 7 ON	0 to 13.8	0 to 17.4	0 to 28.2	0 to 29.0	0 to 52.2
Output Current (nominal) (Amps)		53	43	27	23	13
Maximum Output Power (Watts) <sup>(3)</sup>		600	600	600	600	600
Current Limit (Amps) <sup>(4)(5)</sup>		≥55.1	≥45.1	≥28.3	≥28.3	≥13.6
Overvoltage Protection (OVP) (Volts d-c) <sup>(6)</sup>		14.5 - 16.9	18.2 - 21.8	29.5 - 34.3	29.5 - 34.3	54.8 - 64.3
Efficiency (% typ.)	AC Input 100V	76	79	80	80	81
	AC Input 200V	79	82	83	83	84
Maximum Ripple & Noise <sup>(7)</sup> (mV, p-p)	0°C ≤ 70°C	150	150	150	150	350
	-10°C ≤ 0°C	200	200	200	200	400

- (1) To adjust output voltage down to approximately 0V requires that DIP SW1, position 7 be set to ON. Refer to Table 5 for minimum conditions required to maintain proper operation of alarm relay, meter (AM Models only) and VDC ON/ALARM indicator. Models with suffix "Z" allow adjustment down to 0V without restrictions for maintaining VDC ON indicator, meter and alarm functionality.
- (2) Using trimpot to attain voltages outside the specified adjustment range may trigger overvoltage (PAR 3.6.1) faults. Recovery is by removing, and after approximately 40 seconds, reapplying AC input power or by reset (open and close) at ±RC terminals (no delay).
- (3) See Figure 2 for power derating.
- (4) CAUTION: The unit may be damaged if operated under overcurrent or shorted conditions for more than 30 seconds. If current exceeds limit (105% of nominal), output voltage starts to drop. If overload condition continues, current up to 130% of nominal may be experienced.
- (5) Constant current limit with automatic recovery (see PAR. 3.6.2).
- (6) When overvoltage is detected, output is shut OFF. Recovery is by removing, and after approximately 40 seconds, reapplying AC input power or by reset (open and close) at ±RC terminals (no delay).
- (7) Measure with JEITA RC-9131A probe, bandwidth of scope: 100MHz.



**FIGURE 2. POWER RATING VS. TEMPERATURE**

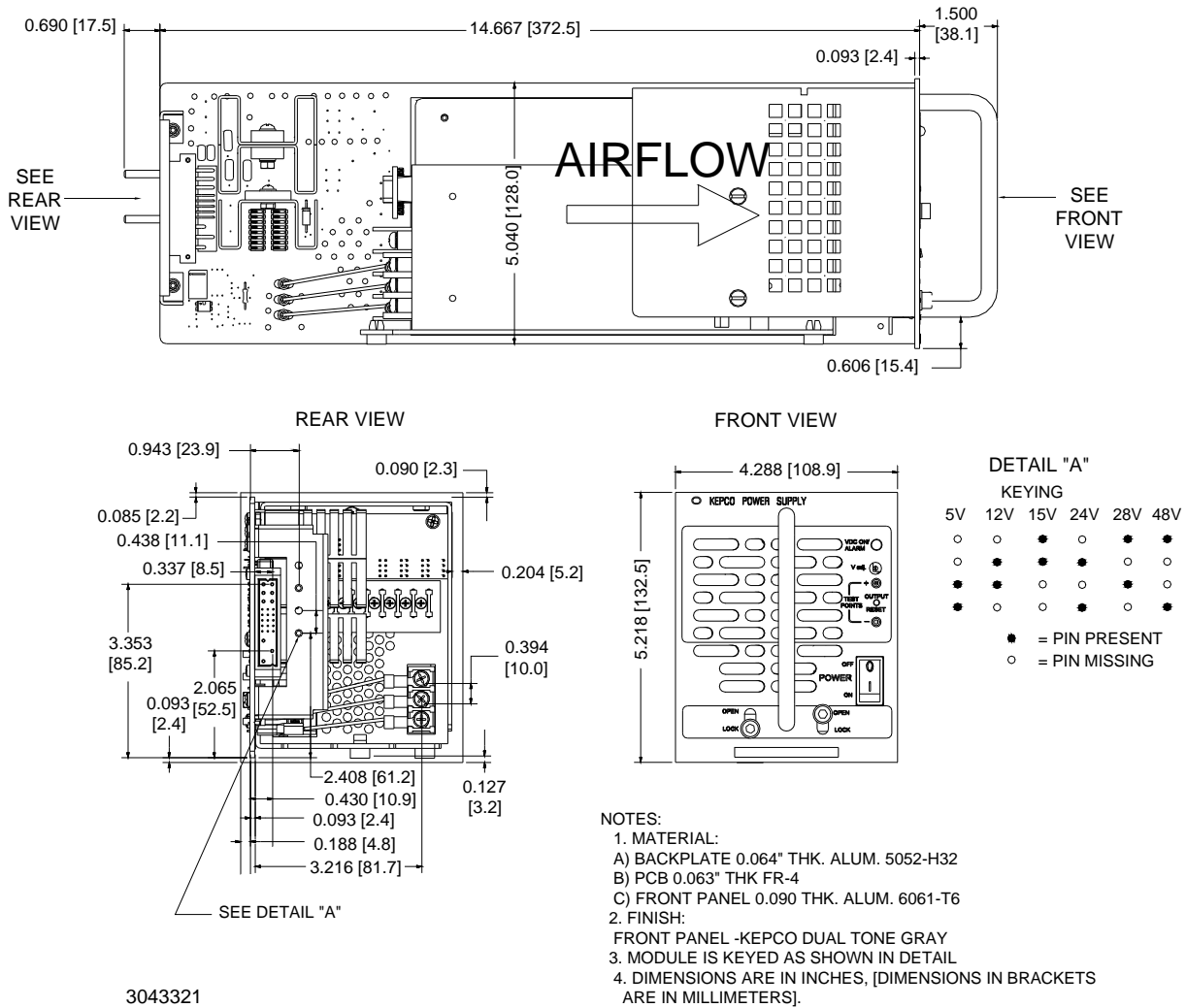
**TABLE 3. POWER SUPPLY RATINGS AND SPECIFICATIONS**



CHARACTERISTIC	SPECIFICATION	CONDITION/NOTES
Input Voltage	Nominal: 100-120V a-c, 200-240V a-c Range: 85-265V a-c, 120-330V d-c	0 to 100% load, -10 to 50°C CAUTION: Input voltage exceeding specifications may damage the unit.
Input Source Frequency	Nominal: 50-60 Hz Range: 47-63 Hz	0 to 100% load, -10 to 50°C
Input Current: (Maximum Load At 25°C with Nominal Output Voltage)	8.1A rms max.	100 - 120V a-c
	3.9A rms max.	200 - 240V a-c
Switching Frequency	200KHz typ.	Forward Converter
Input Protection	The internal power supply is protected against shorts by an input fuse. Fuse value 10A at 250 Volts	
Input Surge cold start, interval > 30 sec (First surge only, not including current flow into EMI filter)	15A typ., 20A max. first surge	100 - 120V ac
	30A typ., 40 max. first surge	200- 240 V ac
Leakage Current:	0.75mA max.	240V a-c, 60Hz per IEC 60950 and UL60950
Power Factor	Meets EN 61000-3-2	Rated output, rated input
Transient Recovery excursion characteristic recovery time	±4% maximum	50% to 100% load, transient time >50µsec
	1 ms maximum	
Stabilization	Source Effect (min - max)	±0.1% Typical, ±0.2% Maximum
	Load Effect	±0.6% Typical, ±1% Maximum (default) ±0.6% Typical, ±1% Maximum (see PAR. 3.8)
	Temperature Coefficient	<0.02% per °C
	Combined Effect	±1.2% Typical, ±2.2% Maximum
	Time Effect	0.2% Typical, 0.5% Maximum
Start-up Time	525 msec Typical, 900 msec Maximum	100V a-c
	275 msec Typical, 550 msec Maximum	240V a-c
Output Hold-up Time	20 msec Typical (28V model: 15 msec Typical)	
Overvoltage Protection	When the Power Supply goes into an overvoltage condition, the output is cut OFF. See PAR. 3.6.1.	
Remote Control ON/OFF:	±RC pins control on/off as follows: "High", 2.4V to 12V (or open), unit OFF- Fan Off; "Low", 0.0V to 0.8V (or shorted), unit ON. Source current: 1.6mA maximum at low level Sink current: 3.5 mA maximum at high level.	Must be enabled by DIP switch positions 3 and 4 (see PAR. 3.5).
Meter (AM Models only) (displays voltage or current; front panel switch-selectable)	Voltmeter Accuracy: ±3%  Ammeter Accuracy: ±5% for loads between 10%-100%	Voltmeter reads sense lines; use remote sensing to display voltage at load. Ammeter accuracy degrades significantly for loads less than 10%.
Operating Temperature:	-10 to 50°C	(see Figure 2.)
Startup Temperature	-20 to -10°C	(see Figure 2.)
Storage Temperature:	-30°C to +85°C	

**TABLE 3. POWER SUPPLY RATINGS AND SPECIFICATIONS (CONTINUED)**

CHARACTERISTIC	SPECIFICATION	CONDITION/NOTES
Withstanding voltage: (at 15-35°C ambient, 10-85% relative humidity)	2500Va-c for 1 minute. Cutout current is 20mA	Between input and ground
	500Va-c for 1 minute. Cutout current is 100mA	Between output and ground
	3000Va-c for 1 minute. Cutout current is 20mA	Between input and output terminal
Insulation Resistance: (at 25°C, 65% relative humidity)	100 Megohms minimum (500Vdc)	Between output and ground, input and ground, and input and output,
Humidity:	Operating: 10% to 90% relative humidity Non-operating: 10% to 95% relative humidity	Noncondensing, Wet Bulb temperature <35°C
Vibration:	5-10 Hz., 10mm amplitude, 10-55 Hz., acceleration 64.3ft./s <sup>2</sup> (19.6M/s <sup>2</sup> ) (2g)	Non-operating 1 hr. on each of 3 axes, sweep time 10 minutes
Shock:	Acceleration: 643.5ft./s <sup>2</sup> (196.1M/s <sup>2</sup> ) (20g), Pulse Duration: 11ms ± 5 msec	Non-operating, 1/2 sine pulse, three shocks on each axis, Power Supply is fixed on its bottom side
Safety:	Recognized component per UL 60950-1 (U.S. and Canadian), CE Mark (RoHS versions)	Applies when input voltage is: 100-240V a-c, 50-60Hz, ambient temperature 40°C max.
RoHS Compliance	RoHS versions available; contact Kepco Sales for further information.	
EMC Emission - Conducted:	Designed to meet FCC Class B, VCCI-Class B, EN55011-B, EN55022-B	
EMC Emission - Radiated:	Designed to meet FCC Class B, VCCI-Class B, EN55011-B, EN55022-B	
EMC - Power Factor Harmonic Current (PFHC)	Designed to meet EN61000-3-2	
EMC Immunity	Designed to meet EN61000-6-2	
EMC Radiated susceptibility:	Designed to meet EN61000-4-3 level 3	normal operation
EMC Conducted susceptibility:	Designed to meet EN61000-4-6 level 3	normal operation
ESD:	EN61000-4-2, level 3	normal operation
Electrical fast transient burst:	EN61000-4-4 level 3	normal operation
Surge withstand:	EN61000-4-5, level 3	No damage
Power Frequency Magnetic Field:	Designed to meet EN61000-4-8, level 4	normal operation
Voltage dips interruptions and variations	EN61000-4-11	normal operation
	Semi F47	200V a-c only
Dimensions:	5.22 in. (132.5 mm) x 4.288 in. (108.9 mm) x 16.86 in. (428.2 mm) (See Figure 3)	
Mounting:	Plug-in	
Cooling:	Forced air flow - fan	
Frame Material/Cover Material:	Steel	
Weight	7.2 lbs, 3.3Kgs. maximum	



**FIGURE 3. MECHANICAL OUTLINE DRAWING OF THE HSF A 600W POWER SUPPLY**

### 3. FEATURES

#### 3.1 DIP SWITCH CONFIGURATION

The HSF A 600W Series incorporates two DIP switches, SW1 and SW2 (see Figure 4), which must be configured before the unit is installed in the rack adapter. The DIP switch functions are explained in Table 4.



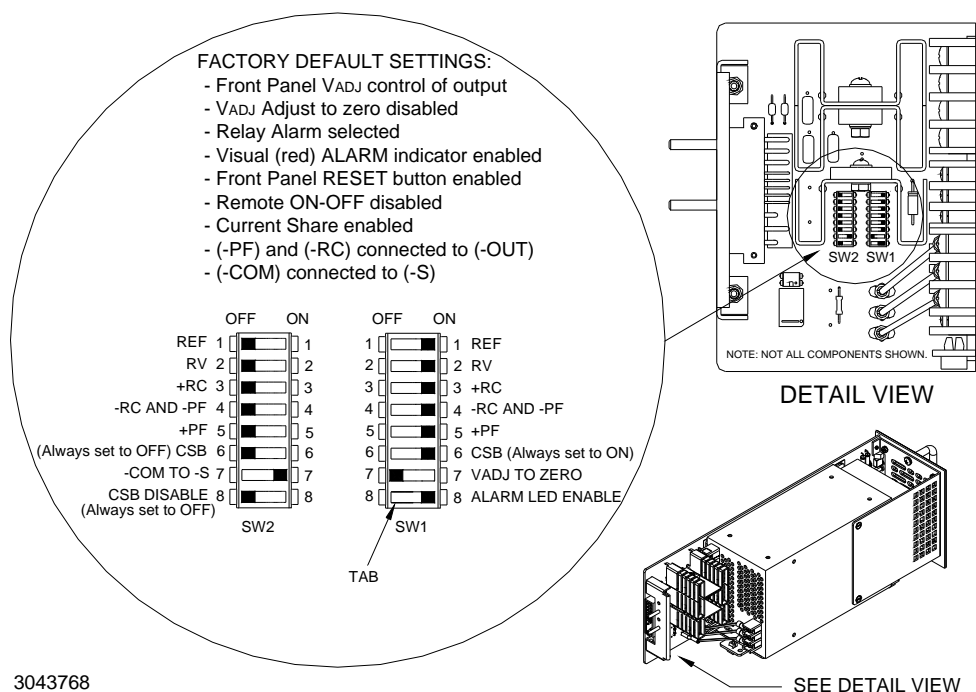
**TABLE 4. DIP SWITCH 1 AND 2 FUNCTIONS**

DIP Switch 2 (left)		DIP Switch 1 (right)	
Position	Function	Position	Function
1 REF	<b>OFF:</b> Front panel V <sub>adj</sub> controls output. See PAR. 3.4.1.	1 REF	<b>OFF:</b> Remote voltage or resistance controls output. See PAR. 3.4.2.
2 RV	<b>ON:</b> Remote voltage or resistance controls output. See PAR. 3.4.2.	2 RV	<b>ON:</b> Front panel V <sub>adj</sub> controls output. See PAR. 3.4.1.
3 +RC	<b>OFF:</b> Allows use of front panel RESET button. <b>ON:</b> Allows use of remote on/off. See PAR. 3.5.	3 +RC	<b>OFF:</b> Allows use of remote on/off. <b>ON:</b> Allows use of front panel RESET button. See PAR. 3.5.
4 -RC & -PF	<b>OFF:</b> Allows use of front panel RESET button. <b>ON:</b> Allows use of remote on/off. See PAR. 3.5.	4 -RC & -PF	<b>OFF:</b> -PF and -RC isolated from PF/RC Common. <b>ON:</b> -PF and -RC connected to PF/RC Common. See PAR. 3.7.2.2.
5 +PF	<b>OFF:</b> Alarm signal from internal isolated relay contacts. See PAR. 3.7.2.1. <b>ON:</b> Enables optically-coupled logic alarm. See PAR. 3.7.2.2.	5 +PF	<b>OFF:</b> Enables optically-coupled logic alarm. See PAR. 3.7.2.2. <b>ON:</b> Alarm signal from internal isolated relay contacts. See PAR. 3.7.2.1.
6 CSB (1)	<b>OFF:</b> Enables Current Share (always off). <b>ON:</b> N/A	6 CSB (1)	<b>OFF:</b> N/A <b>ON:</b> Enables Current Share (always on).
7 -COM to -S	<b>OFF:</b> Isolates -COM from -S. <b>ON:</b> Connects -COM to -S.	7 VADJ to 0	<b>OFF:</b> V <sub>adj</sub> adjusts output per Table 2. <b>ON:</b> V <sub>adj</sub> adjusts output to zero. See Par. 3.4.1 and Table 5.
8 PVB (2) Disable	<b>OFF:</b> Enables current sharing (always off) <b>ON:</b> N/A	8 Alarm LED	<b>OFF:</b> VDC ON/ALARM stays off for parallel condition. <b>ON:</b> VDC ON/ALARM glows red for alarm condition. See Par. 3.7.1

NOTE: **BOLD** settings indicate factory defaults.

(1) CSB (Current Share Bus bypass) must be in factory default position to enable current sharing.

(2) PVB (Programming Voltage bypass) must be in factory default position to enable current sharing.



**FIGURE 4. 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. If the unit is connected in a parallel configuration, the indicator lights red if the unit shuts off automatically, or the POWER switch is set to OFF.



**CAUTION: DO NOT repeatedly toggle the power ON/OFF switch as this may cause unit to fault. The ON/OFF switch must be set to OFF before removing unit from rack adapter.**

If remote on-off is not enabled (see PAR. 3.5), 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 2; test points are available at the front panel for monitoring the DC output.

Figure 5 shows the location of all operating controls, indicators and test points followed by an explanation of each.

### 3.3 KEYING

Keying of the HSF A 600W is established at the factory. The output voltage determines which key pins are installed (see Figure 3, 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.

### 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, Vadj (see Figure 5 for location). Configuration options are as follows:

Output from maximum to minimum specified in Table 2 (Figure 6A (factory default)).

SW1: pos 1 to ON, pos 2 to ON; pos 7 to OFF

SW2: pos 1 to OFF, pos 2 to OFF

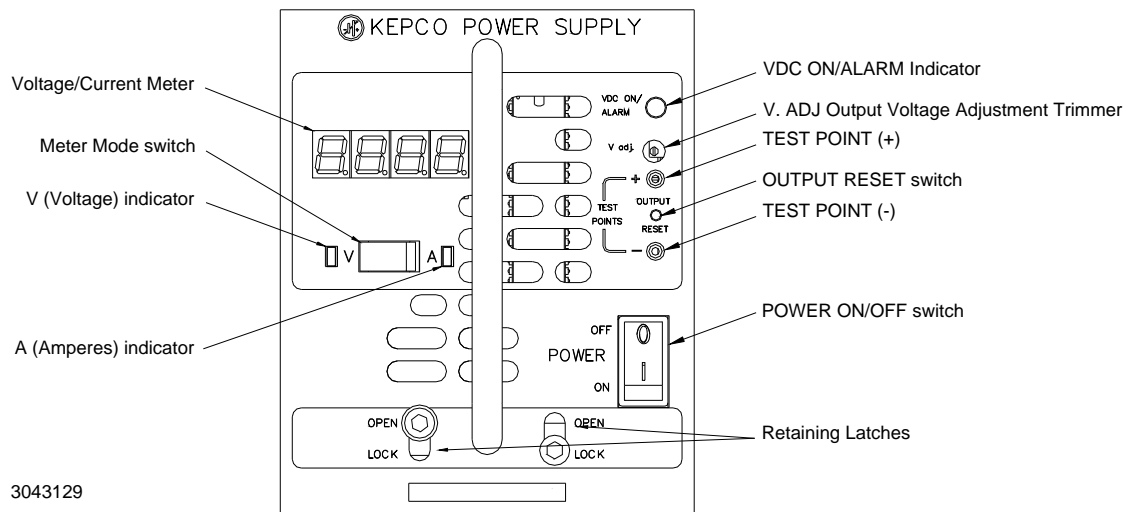
Output from maximum to 0V (requires multiple turns of Vadj for full range)

SW1: pos 1 to ON, pos 2 to ON, pos 7 to ON

SW2: pos 1 to OFF, pos 2 to OFF

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.

The minimum output voltage required to ensure proper operation of the alarm relay, meter (on AM models) and LED indicator is listed in Table 5.



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- VDC ON/ALARM indicator. Lights green when unit is operating. When enabled by DIP switch configuration, lights red to indicate loss of output voltage in parallel configuration only (see PAR. 3.7.1).
- V.ADJ Output voltage adjustment trimmer: Adjusts output voltage within limits specified in Table 2 (see PAR. 3.4.1). Not functional if remote output control is enabled (see PAR. 3.4.2).
- TEST POINT (+, -): Connect to voltmeter to monitor d-c output voltage.
- OUTPUT RESET switch. Used to recycle power in the event of an alarm condition (see PAR. 3.6). Not functional when remote on/off control is enabled (see PAR. 3.5).
- POWER ON/OFF switch. Applies power to the unit.  
**CAUTION: Power must be OFF before unit is removed from the rack adapter.**
- Retaining Latches (2). Prevents inadvertent removal of unit from rack adapter (see PAR. 3.9).
- **Option M Models only:** Voltage/Current meter: Monitors output voltage or current according to setting of Meter Mode switch. NOTE: Use remote sensing for voltmeter to display voltage at the load.
- **Option M Models only:** Meter Mode slide switch: Set to V for display to show output voltage, set to A to show output current.
- **Option M Models only:** V indicator: Lights green to indicate meter is showing Volts.
- **Option M Models only:** A indicator: Lights amber to indicate meter is showing Amperes.



**FIGURE 5. FRONT PANEL CONTROLS, INDICATORS AND TEST POINTS (HSF AM, TYPICAL)**

### 3.4.2 REMOTE VOLTAGE CONTROL

Output voltage can be controlled remotely by means of an external voltage or resistance instead of by Vadj. Configure the DIP switches as follows:

SW1: pos1 to ON, pos2 to ON; SW2: pos 1 to OFF, Pos2 to OFF

NOTE: Configuring the unit for remote output voltage control disables the front panel Vadj control. To restore Vadj control, configure the DIP switches per PAR. 3.4.1.

When DIP switch positions 1 and 2 are configured as noted above, output voltage can be adjusted by either an external trimmer pot (resistance) or by an external variable voltage source 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 pin 2 (REF, Reference), pin 12 (RV, Remote Voltage), and pin 10 (-COM, Common) of the rack adapter I/O connector to the trimmer control or external voltage source.

**Using External Voltage to Control the Output.** Connect the external voltage source across the RV and -COM pins as shown in Figure 7B. By adjusting an external 0 to 6V voltage source (0 to 5.5V for the 48V model), the HSF (A, AM) output voltage can be adjusted within the range specified in Table 2. To ensure proper operation of the alarm relay, meter (Option M Models only) and VDC ON/ALARM indicator, do not adjust the external voltage below minimum listed in Table 5.

**Using External Resistance to Control the Output.** Connect the unit to the RV, -COM and REF pins as shown in Figure 7A. Suggested value for the trimmer control is 20K ohms. Referring to Figure 7A, Resistor R is used to obtain minimum output voltage required to ensure proper operation of the alarm relay, meter (AM Models only) and VDC ON/ALARM indicator; see Table 5 for values.

- NOTES: 1. Output voltage may not adjust to 0V due to residual trimmer resistance.
2. If remote output control is not implemented, the factory default for positions 1, 2 and 7 of DIP switches SW1 and SW2 must be restored (Figure 6A).
3. It is possible that 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.

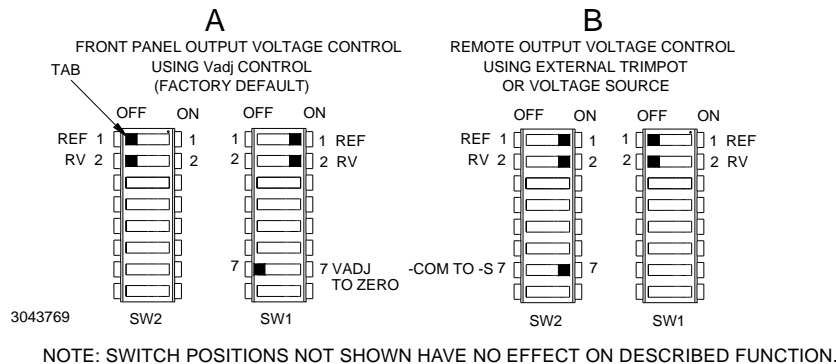
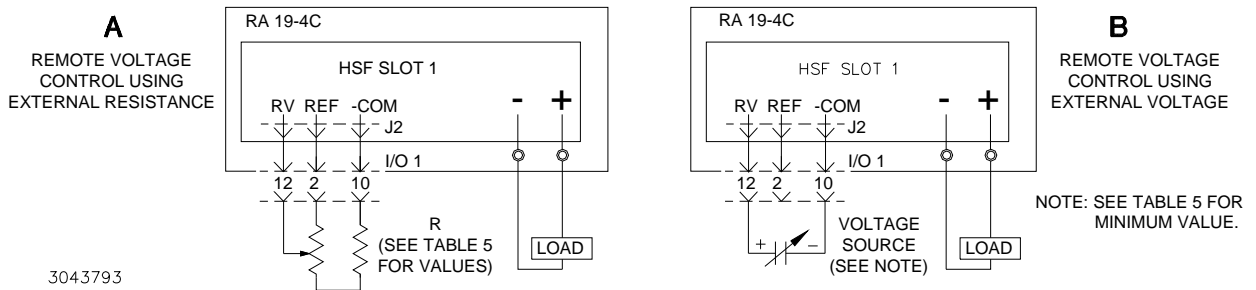


FIGURE 6. DIP SWITCH SETTINGS FOR CONTROL OF OUTPUT VOLTAGE

**TABLE 5. MINIMUM CONDITIONS FOR RELAY, METER AND LED OPERATION**

HSF A, AM MODEL	12-53A, AM	15-43, AM	24-27A, AM	28-23A, AM	48-13A, AM
For HSF A and AM models, minimum output voltage required for continuous alarm relay, meter (AM Models only) and VDC ON indicator functioning (Volts d-c) <sup>(1)</sup>	7	7	7	7	7
Minimum resistance of Limit resistor R (Figure 7A) in series with 20K ohm Trimpot to ensure proper operation of alarm relay, meter (AM Models only) and VDC ON indicator (Ohms). <sup>(1)</sup>	11.2K	9.76K	5.36K	5.36K	2.49K
Minimum external voltage (Figure 7B) to ensure proper operation of alarm relay, meter (AM Models only) and VDC ON indicator (Volts d-c). <sup>(1)</sup>	2.5	2.33	1.46	1.46	0.73
Voltage source range (Volts d-c)	0 - 6	0 - 6	0 - 6	0 - 6.25	0 - 5.5

(1) If operating below minimums listed, see PAR. 3.7.2.2 to implement  $\pm$ PF alarm signals to monitor power supply status.



**FIGURE 7. CONNECTIONS FOR REMOTE VOLTAGE CONTROL**

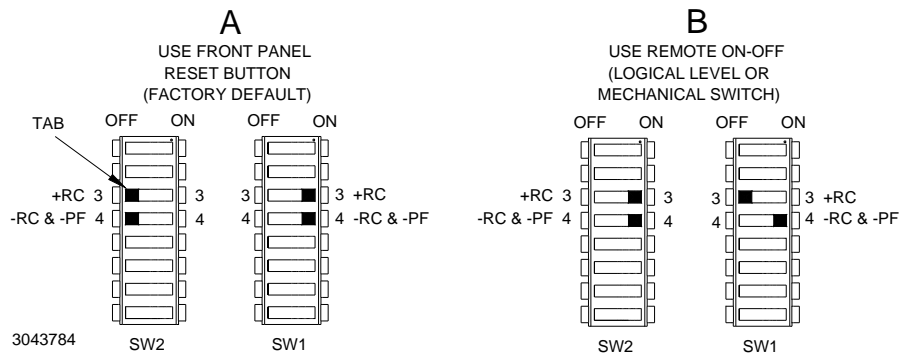
### 3.5 REMOTE ON-OFF

When power is ON at the source, the output may be turned ON or OFF using the  $\pm$ RC signals if the remote ON-OFF feature is enabled. Note that when remote ON-OFF is enabled, the RESET OUTPUT switch does not function. Remote ON-OFF is enabled by setting DIP switch positions 3 and 4 as shown in Figure 8B. The +RC and -RC signals (at the rack adapter I/O connector, pins 15 and 8, respectively) then turn the unit on or off.

These pins accept a logic level (2.4V to 12V maximum for “high” and 0.0 to 0.8V for “low”), or a contact closure. When the  $\pm$ RC pins are open, using either a mechanical switch or a high level logic signal, the HSF (A, AM) 600W output is cut OFF. When the  $\pm$ RC pins are shorted, the output returns to within specifications. At low level logic, the maximum sink current is 3.5mA.

Positions 3 and 4 of both DIP switches must be restored to the factory default setting (Figure 8A) if remote ON-OFF is not used.

**NOTE:** The +RC pin is not isolated from DC output. -PF and -RC are connected together and cannot be isolated from each other (unlike earlier (non A) HSF 600W models). This return is connected to the power supply -OUTPUT. Please contact Kepco if application requires remote control to be isolated from DC output or from PF signal.



**FIGURE 8. DIP SWITCH SETTINGS FOR USING RESET BUTTON OR REMOTE ON-OFF**

### 3.6 PROTECTION CIRCUITS

The following protection features are implemented in the HSF A 600W Series: overvoltage and overtemperature (PAR. 3.6.1), overcurrent (PAR. 3.6.2), fan failure (PAR. 3.6.3), and undervoltage (PAR. 3.6.4). The HSF A 600W Series provides a configurable visual alarm (see PAR. 3.7.1) as well as an option to use either relay contacts or logic levels for alarm signals (see PAR. 3.7.2)

#### 3.6.1 OVERVOLTAGE AND OVERTEMPERATURE PROTECTION

When the output voltage of the HSF A 600W Power Supply increases beyond the specified values (see Table 2), at some point the output is cut OFF. To restart (reset) the unit, press and release the OUTPUT RESET switch on the front panel or, if the remote on/off feature is in use (see PAR. 3.5), open connection between the  $\pm$ RC pins and then reconnect the pins. 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.

When internal temperature of the HSF A 600W Power Supply increases beyond the allowable limit, the output is cut 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 until unit cools, 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.

#### 3.6.2 OVERCURRENT SETTING AND PROTECTION

The Overcurrent Protection (OCP) characteristic is constant current limiting, automatic recovery. OCP operates when output current exceeds 105% (119% for 24V model) of maximum d-c output current specification. The output automatically recovers when the overload condition is removed.



**CAUTION: Operating the unit under overcurrent or shorted conditions for more than 30 seconds may damage the unit.**

The OCP setting is fixed and is not user-adjustable.

#### 3.6.3 FAN FAILURE

A cutoff of the fan supply voltage or a decrease in fan speed 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. 3.7.2). To restart (reset) the unit, press and release the OUTPUT RESET switch on the front panel or, if the remote on/off feature is in use (see PAR. 3.5), open the connection between the  $\pm$ RC pins and then reconnect the pins. 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.

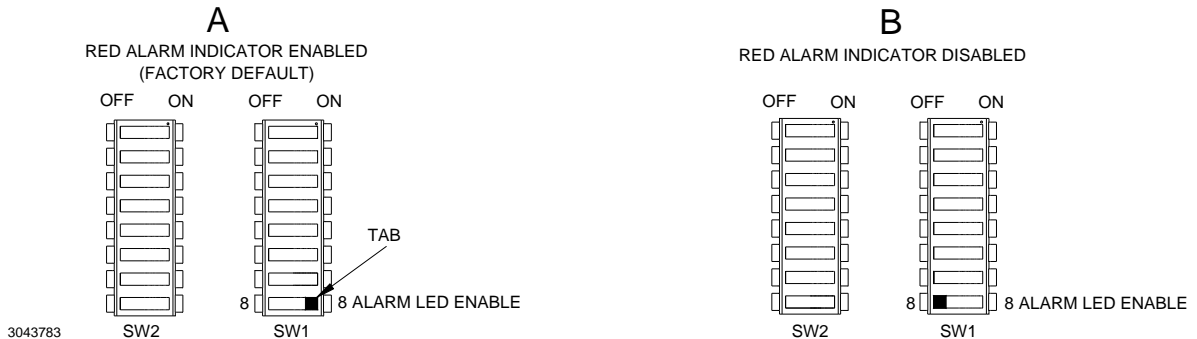
### 3.6.4 UNDERVOLTAGE

If power supply output voltage either falls within 40 to 80% of the rated output voltage value, or is programmed below the minimum values listed in Table 5, an alarm occurs if the internal relay alarm (factory default, see PAR. 3.7.2.1) is enabled. To restart (reset) the unit, press and release the OUTPUT RESET switch on the front panel or, if the remote on/off feature is in use (see PAR. 3.5), open the connection between the  $\pm$ RC pins and then reconnect the pins. 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. To enable the alarm function when operating below the minimum values listed in Table 5, refer to PAR. 3.7.2.2 to configure the optically-coupled alarm.

## 3.7 ALARM SETTINGS

### 3.7.1 VISUAL ALARM.

When the unit is connected in a parallel configuration, the front panel VDC ON/ALARM indicator is normally configured to light red if the respective power supply output voltage is lost or if the POWER switch is set to OFF. This is enabled when DIP switch 1, position 8 is set to ON. This can be useful to indicate the loss of output voltage from one parallel-connected power supply that may not be readily apparent. For the visual alarm to function properly the minimums specified in Table 4 must be observed.



**FIGURE 9. DIP SWITCH SETTINGS FOR RED ALARM INDICATOR ENABLE/DISABLE**

If desired, the red alarm indication of the VDC ON/ALARM indicator can be disabled by setting DIP switch 1 position 8 to OFF.

### 3.7.2 ALARM SIGNALS.

Either of two options are available for signalling alarms: isolated relay contacts (factory default, PAR. 3.7.2.1) or logic level alarm signals  $\pm$ PF (PAR. 3.7.2.2). The  $\pm$ PF logic level alarm option must be used if the power supply is intended to operate below the minimum voltages listed in Table 5.

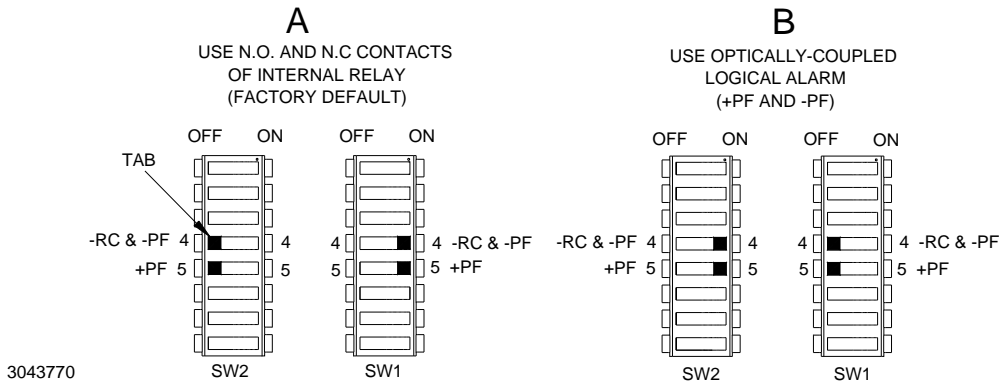
#### 3.7.2.1 INTERNAL ISOLATED RELAY ALARM

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 A power supplies.) Setting position 5 of the DIP switches as shown in Figure 10A 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).

#### 3.7.2.2 OPTICALLY-COUPLED LOGICAL ALARM

The second option uses optically-coupled logic level alarm signals, +PF (pin 5 of the rack adapter I/O connector) and -PF (pin 13), provided directly from the internal power supply that is the heart of the HSF A power supply. The optically-coupled logic alarm is selected by setting position 5 of the DIP switches as shown in Figure 10B. This option functions even with output voltage adjusted below the minimum voltages specified in Table 5.

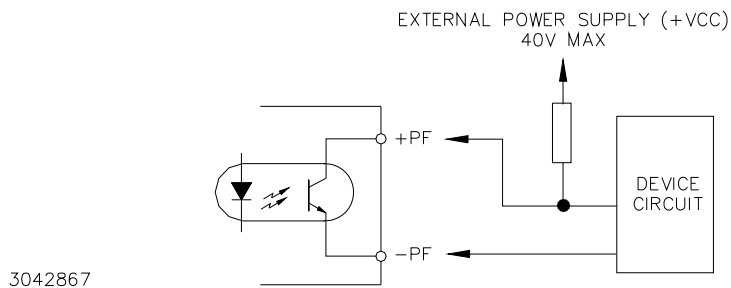
NOTE: Unlike earlier (non A) HSF 600W models, -PF and -RC are connected together and cannot be isolated from each other. This return is connected to the power supply -OUTPUT when position 4 of SW1 is set to ON (factory default). If it is necessary to isolate the -PF and -RC from the power supply output, set position 4 of SW1 to OFF.



**FIGURE 10. DIP SWITCH SETTINGS FOR OPTICALLY COUPLED LOGICAL ALARM**

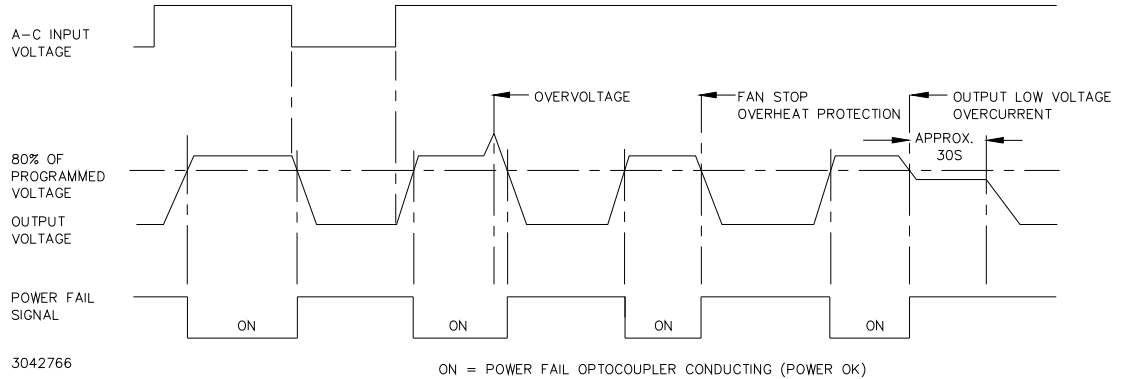
The logic alarm circuit is a diode transistor optical coupler (see Figure 11). The transistor is normally conducting. When the alarm is activated upon detection of power loss, overvoltage, fan fault, overtemperature or overcurrent condition, the transistor cuts off and the collector emitter circuit is open. Figure 12 is a timing diagram of the power fail signal.

The default state of the alarm is logic low. The sink current for the optocoupler is 50mA maximum, the maximum collector to emitter saturation voltage is 0.40 Volts, and the collector to emitter voltage is 40 volts maximum. The +PF signal is isolated from the AC input and DC output. The -PF signal (in common with -RC) is connected to -OUTPUT when position 4 SW1 is set to ON (factory default). It is possible to isolate both -PF and -RC from -OUTPUT by setting SW1 of position 4 to OFF.



**FIGURE 11. OUTPUT ALARM CIRCUIT OPTICALLY ISOLATED**





**FIGURE 12. ±PF POWER FAILURE OPTOCOUPLER TIMING DIAGRAM**

### 3.8 LOCAL/REMOTE SENSING

HSF A 600W Power Supplies allow remote error sensing which can compensate up to 0.4 Volts per load wire. Local/Remote error sensing is configured by means of separate DIP switches mounted on the RA 19-4C Rack Adapter (see RA 19-4C Rack Adapter Operator Manual). Either local or remote sensing **MUST** be used, otherwise the units will not operate.

### 3.9 RETAINING LATCHES

HSF A 600W series power supplies are provided with (2) retention latches located at each side of the bottom edge of the front panel (see Figure 5). 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 A power supply in the rack adapter for shipping purposes.

#### 4. LOAD CONNECTION

Connect the load to (+) and (-) terminals at the rear panel of the Rack Adapter (see RA 19-4C Instruction Manual for details).

#### 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 or by the Rack Adapter DIP switches. These connections, including the configuration of the two internal HSF A DIP switches, are described in the Rack Adapter Instruction manual, and include:

- Using one power supply to control the output of multiple supplies.
- Using parallel master/slave configurations (for increased current or redundancy) where the user either predetermines the master or allows the load to determine which is the master. These configurations also cover the use of the Current Balancing feature of the HSF A power supply.
- Using series configurations (for increased voltage).
- Using open-on-fail or close-on-fail alarm schemes with multiple power supplies.

NOTES: 1. To enable current share, the difference between voltage settings of parallel connected units should be less than 0.5% of the nominal voltage value of the units. Output voltage adjustment should be done at same load for each unit.

2. An overshoot of about 1% of nominal voltage occurs upon power up of each unit. When powering up with no load, overshoot may last up to 15 seconds and alarm may be temporarily triggered on one of the other parallel-connected units.

3. Load effect specifications will not be met when units are operated in redundant mode with load less than 10% per unit.

4. **Minimum Load.** A minimum load is required to operation without voltage set restrictions (see Note 5, below). The minimum load is defined as:

$$\text{minimum load (Amperes)} = N \times (I/10)$$

where N = the number of units in parallel,

I = Nominal current rating of individual power supply (Amperes).

5. **Voltage Set Restrictions.** When units are at light load (under 10% of nominal), and voltage settings are less than 80% of nominal, voltage set restriction are required. To avoid a "slave idle" condition (PF signal set, red ALARM indicator on) the output voltage of all parallel-connected units must be set within 0.5% of each other and be at least 80% of their nominal (rated) output voltage (90% for 48V model).

NOTE: If older HSF (non -A) models are to be connected in parallel with the models covered in this manual, the voltage restrictions for the HSF A models must be observed: the output voltage of all parallel-connected units must be set within 0.5% of each other and be at least 80% of their nominal (rated) output voltage (90% for 48V model).