
**INSTALLATION, OPERATION and
MAINTENANCE MANUAL**

**MODEL RF1 30 THRU 225A
SCR POWER CONTROLS**



**AMETEK HDR POWER SYSTEMS
3563 INTERCHANGE ROAD
COLUMBUS, OHIO 43204**

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TOLL FREE: 1-888-PWR-CNTL (797-2685)
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SCR Power Controls/Systems & Power Supplies

Dear Client:

On behalf of all of AMETEK HDR's employees, I want to take this opportunity to "thank you" for purchasing an AMETEK HDR Power Systems' SCR Power Control.

We believe AMETEK HDR represents the best overall solution to your SCR Power Control needs in the industry today. We do this by providing a quality manufactured, reliable unit with fast, on-time delivery and a competitive price.

All of our employees are dedicated to your success. If you have any questions, comments or concerns, please call me at 1-888-PWR-CNTL (797-2685).

Sincerely,

AMETEK HDR POWER SYSTEMS

A handwritten signature in black ink that reads "George A. Sites". The signature is written in a cursive style.

George A. Sites
Director of Engineering

GAS/be

REVISION PAGE

Page

Change

Revision

Date

NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.

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AMETEK HDR Power Systems

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Section 1 - DESCRIPTION

1-1 MODELS COVERED

This manual covers the RF1 models rated 30 through 225 amperes and its options.

1-2 GENERAL DESCRIPTION

The RF1 is a solid-state, single-phase, phase fired (PF) SCR power control that will operate on voltages up to 575 VAC. It accepts most standard process command signals and regulates the output voltage. Zero and Span Multi-turn potentiometers are provided to ease calibration. The RF1 utilizes phase-lock loop technology to insure precise timing and noise immunity. The power SCR assembly consists of two SCRs connected back to back, R.C. Snubber and MOV protection. There is also a RF Filter connected across the incoming power terminals to ground. Power terminals are provided to ease installation. Diagnostic indicators are provided to aid troubleshooting.

1-3 APPLICATIONS

The RF1 provides infinitely variable firing angles for precise control of single-phase power to RF Generator Plate Transformers. It is designed to accept a Plate Voltage Feedback signal also.

1-4 SPECIFICATIONS

Refer to Table 1 for specifications on the RF1 Power Control.

1-5 OVERCURRENT TRIP (OC)

An Overcurrent Trip (OC) is included. This circuit trip based on peak currents not RMS currents as most Overcurrent Trips would. The adjustment range is 25 to 200% of the Current Transformers ratio and a Form C relay output is provided.

**Table 1
Specifications for the RF1**

CONTROL METHOD	- Phase firing of back to back SCRs.
VOLTAGE RATINGS	- 120, 240, 400, 480, 575VAC, 3 Ph., 50/60 Hz.
CURRENT RATINGS	- 30, 60, 120, 225
COMMAND SIGNAL	- 4-20ma, 0-5VDC/0-10VDC, manual control.
ISOLATION	- 2500Vrms from line/load to command signal, 500Vrms to ground.
LINEARITY	- Output voltage is linear to command signal when used with external feedback.
FEEDBACK	- External 0-10 VDC
VOLTAGE REG.	- $\pm 1\%$ for $\pm 10\%$ line voltage change.
SCR PROTECTION -	Current surge, overcurrent trip; transient voltage, metal oxide varistor (MOV) and R-C snubber.
ADJUSTMENTS	- Zero and Span, multi-turn.
DIAG. INDICATORS	- Control power, command signal.
AMBIENT TEMP.	- Operating 0 - 50 °C, Storage -10 - 70 °C
WEIGHT	- 30 and 60A 6 lbs - 120 and 225A: 22 lbs.

1-6 OPERATION

The RF1 controls power by the switching action of two SCRs connected in a back to back configuration per phase. The gating of these SCRs is synchronized with the line frequency (either 50 or 60 HZ) by the phase locked loops built into the firing circuit. A soft-start feature is standard, which allows the RF1 to fire into the primary of the plate transformer. The output may be adjusted by the on-board multi-turn potentiometers or by a voltage or current signal from a process controller. The Multi-Turn Zero and Span controls allow the user to calibrate the SCR unit's output to the process command signal. Terminals are available for connection of a remote manual potentiometer.

WARNING
**Hazardous voltages exist at the exposed
heatsink(s) and/or terminals unless the
source is disconnected.**

1-7 DIAGNOSTIC INDICATORS

Two diagnostic indicators (LEDs) are provided: Control Power (Red), lights when control power is applied; Command Signal (Green), varies in brilliance with command signal..

1-8 SELECTING THE PROPER RATED POWER CONTROLLER

Use the Table below to select the proper sized RF1. You will need the incoming line voltage and the transformer leakage impedance. For voltages other than 480V, ratio the incoming voltage using the 480V chart provided below. For example, a 240V system the kVA would be half that on the chart for any given kVA. The kVA is based upon the one cycle surge ratings of the SCRs installed in each of the power controls.

Table 2 – kVA vs. Leakage Impedance

		Leakage Impedance					
Part Number	Current Rating		4%	6%	8%	10%	12%
	30 Amperes		9	13	17	22	30
	60 Amperes	K	9	13	17	22	30
		V					
	120 Amperes	A	19	32	40	54	60
	225 Amperes		37	57	95	107	120

Section 2 - INSTALLATION

2-1 MOUNTING

Prior to mounting, verify the voltage and current rating. The information is provided on the unit's nameplate. Determine the mounting dimensions from the outline drawing Figure 4 or 5, . Mount the RF1 so that airflow is upward through the power controller. Ensure that airflow is unrestricted. Allow plenty of room.

2-2 LINE/LOAD POWER WIRING

Connect the line/load using appropriately sized and insulated wire/cable per the NEC based on the voltage and current rating of the RF1. Refer to Figure 1. Cable lugs are provided on 30 through 225A rated units. Refer to Table 3 for lug sizes and torque information.

WARNING
Hazardous voltages exist at the power controller heatsink(s) and at the load at all times when the input voltage is connected. This condition exists even when the controller is set to deliver zero output.

Table 3
Lug Size/Torque Information - 30 through 225A Models

<u>Model</u>	<u>Size Wire/Cable</u>	<u>Torque</u>
30A & 60A	14 to 1/0 AWG	40 to 50 in. Lbs.
120A	14 to 2/0 AWG	100 to 120 in. Lbs.
225A	6 to 250 MCM	325 in. Lbs.

NOTE: 75°C rated wire (minimum) is required for all power connections to the RF1.

WARNING
Branch circuit overcurrent protection is required to be provided in accordance with the national and/or local code of the inspecting authority or equivalent.

2-3 FAN AND THERMOSTAT WIRING (120A & 225A only)

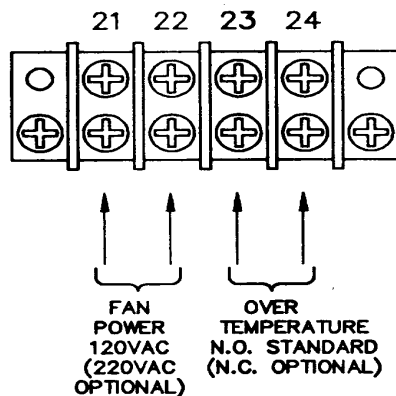
Fans and thermostats are supplied on all units rated 120 and above. The user is responsible for supplying 120VAC for the fans. Fan power should be connected to terminals 21 and 22.

CAUTION

The application of fan power should precede or coincide with the turn-on of the line voltage source that is to be controlled by the source disconnect switch.

Normally Closed thermostats are standard on 120 amp & 225 amp units. Thermostat connections are on terminals 23 & 24.

Figure 1
FAN AND THERMOSTAT TERMINALS



2-4 INPUT LINE VOLTAGE CHANGES

All units are shipped wired for the line voltage specified on the order. If some other voltage is required, it is a simple matter to change it. Open the door on the Power Control and locate transformer T1. Unsolder and move the white/black wire to the appropriate voltage tap on T1. Switch SW3 must be placed in the proper position for the line frequency.

CAUTION

Hazardous voltages exist at the Power Controller's heatsink(s) and at the load at all times when the input voltage is connected. This condition exists even when the Power Controller is set to deliver zero output.

2-5 SAFETY ISSUES

The rated operational voltage of each Power Controller is shown on its nameplate, i.e. 120V, 240V, 400V, 480V and 575V. The Power Controller is designed to operate between +10% and -15% of this rated operational voltage in an Over Voltage Category III environment.

The voltage drop across the switching semiconductor while in the conducting mode is approximately 1.5 volts and is somewhat a function of the current. To calculate the Power Control's power loss, multiply the actual load current times 1.5 times 3 (the number of phases). The minimum operational current is approximately 1 Amp and the maximum off state current is approximately 15 ma.

WARNING

Power Control units are not suitable to provide isolation due to the use of semiconductors and other components that allow a small current to flow from line to load even when the unit is in the non-conducting mode.

The Power Controllers described in this instruction manual are designed to operate in a pollution degree 2 environment.

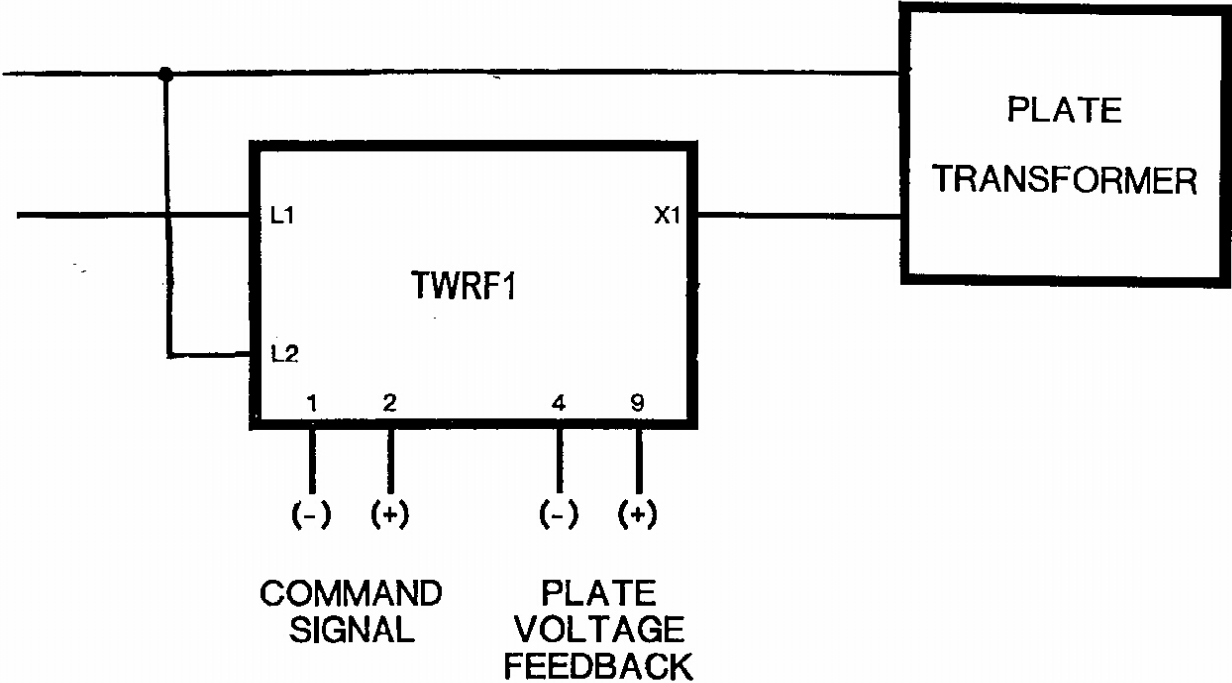


HAZARDS EXIST

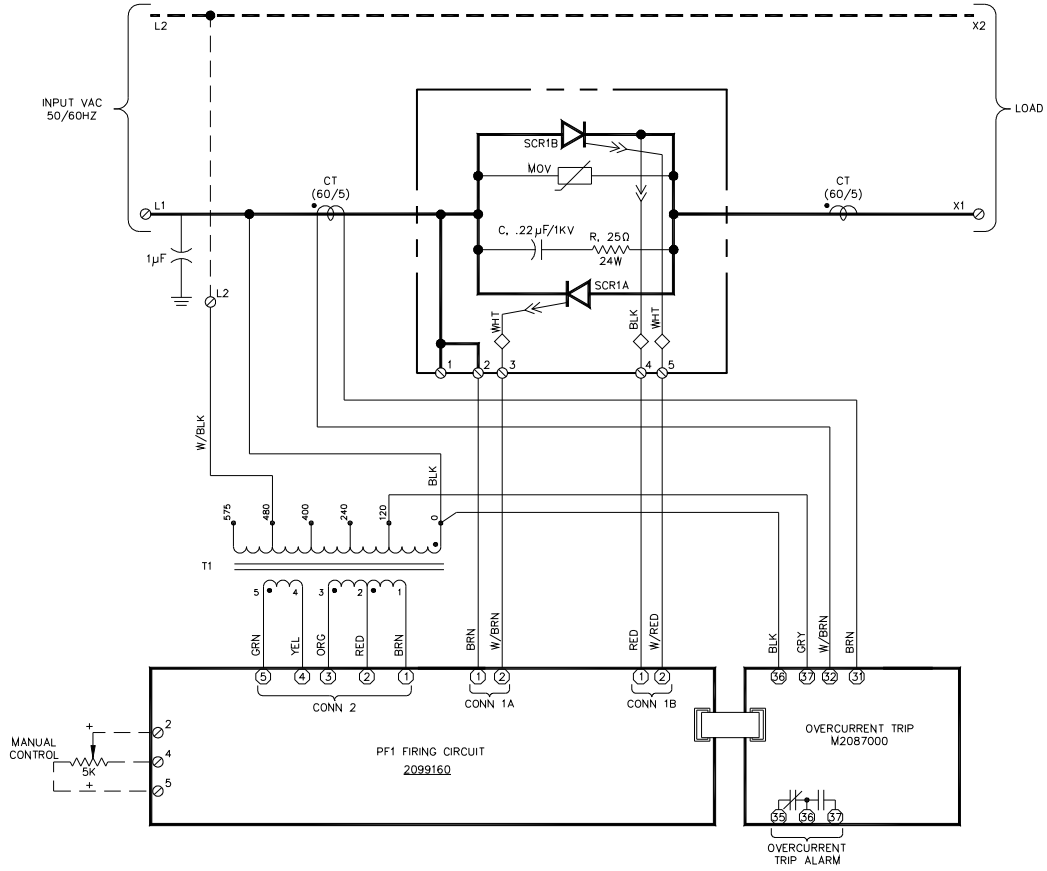


**DANGEROUS VOLTAGES
EXIST**

Figure 2
LINE/LOAD POWER WIRING



SCHEMATIC - RF1 30 & 60 AMPERE



- NOTES:
- 1) SHOWN WIRED FOR 480V.
 - 2) ◇ INDICATE PCB SOLDER CONNECTIONS.
 - 3) ○ INDICATES PLUG IN CONNECTIONS.
 - 4) DASHED LINES INDICATE USER SUPPLIED WIRING.
 - 5) CT REQUIRES 2 PRIMARY TURNS.

Figure 3

OUTLINE AND MOUNTING - RF1 30A AND 60A

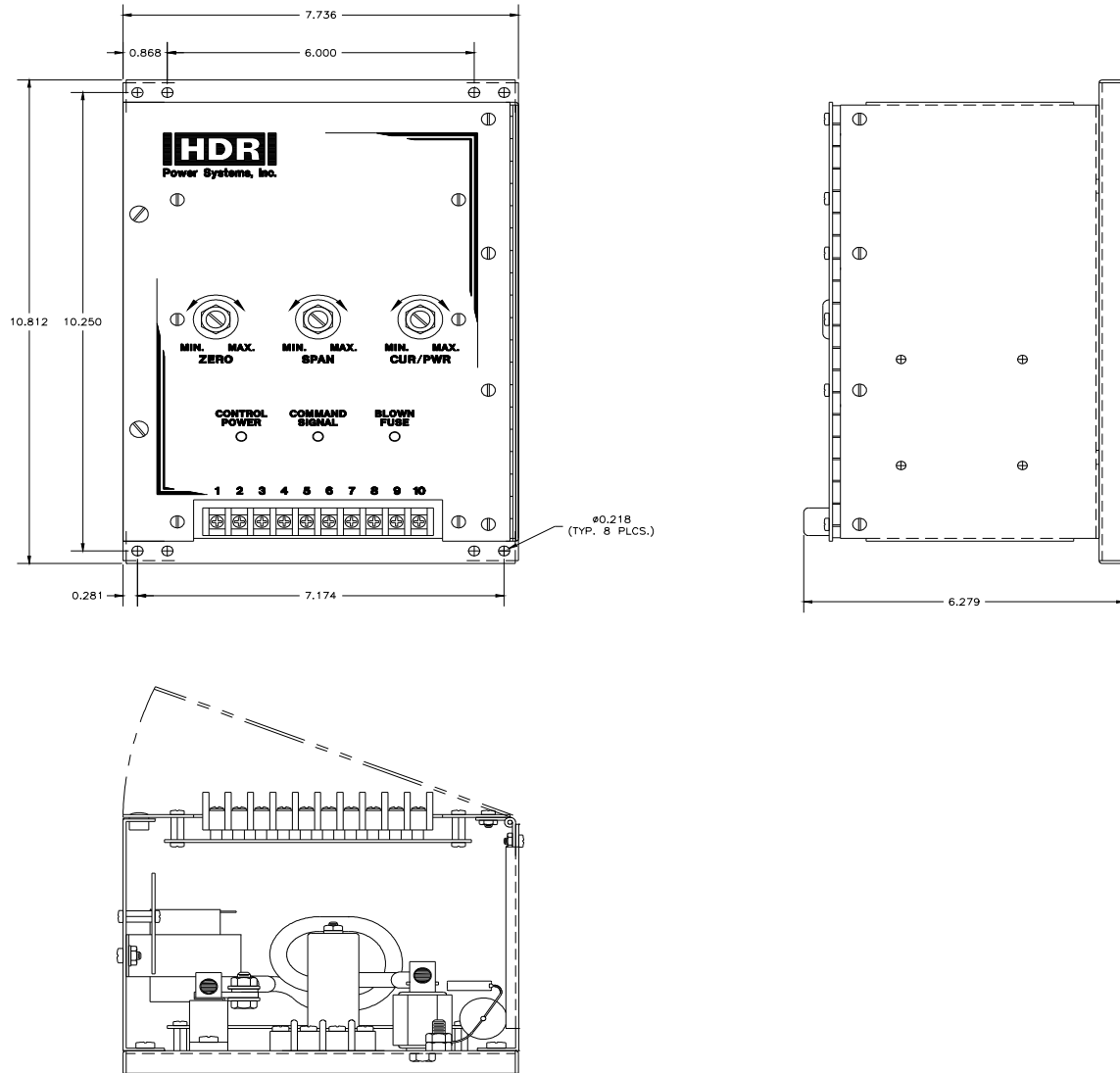


Figure 4

OUTLINE AND MOUNTING - RF1 120 AND 225A

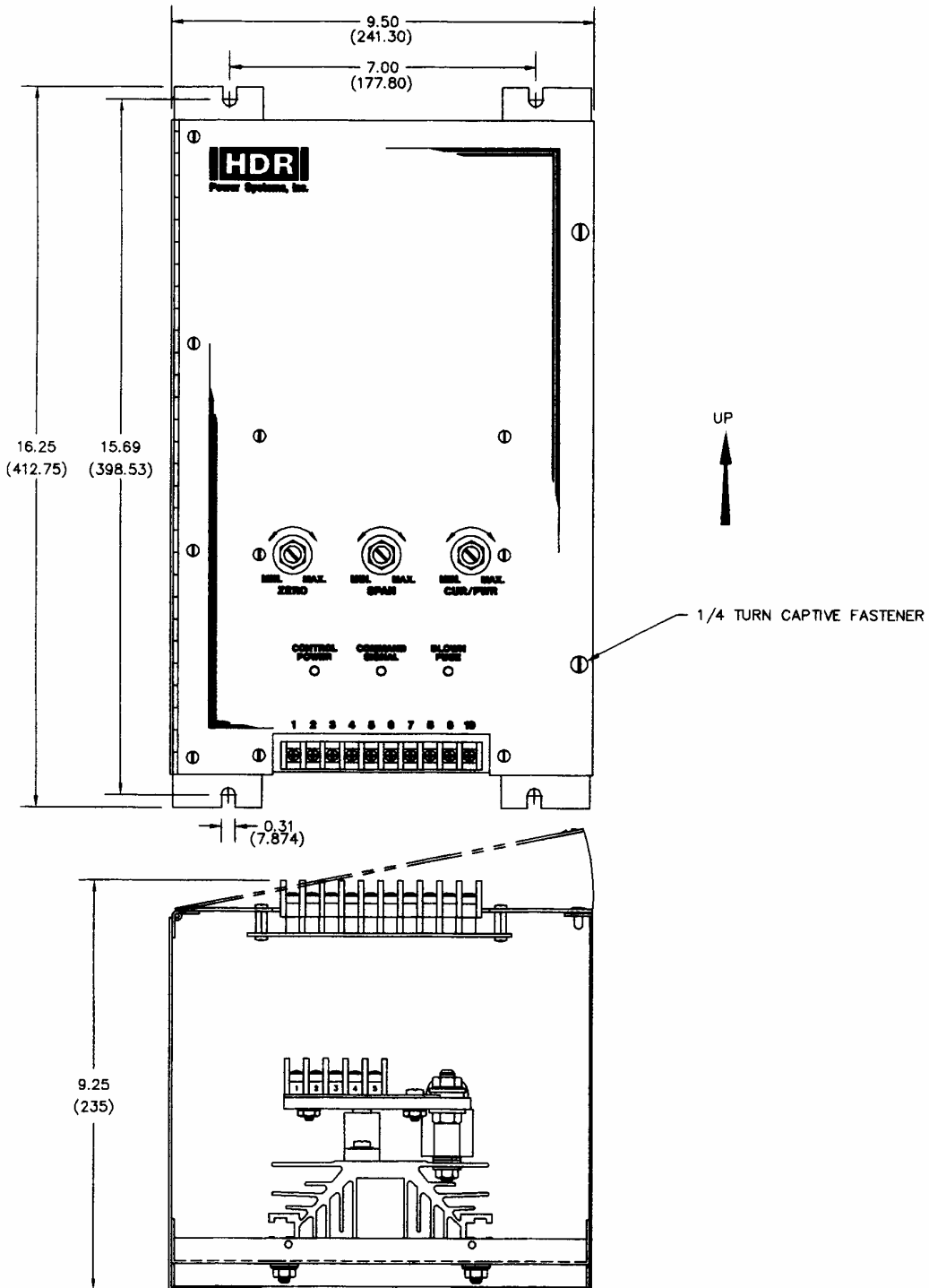


Figure 5

Section 3 - COMMAND SIGNAL CALIBRATION AND WIRING

3-1 ZERO AND SPAN ADJUSTMENTS

All RF1s have multi-turn Zero and Span potentiometers used for matching the SCR Power Control and the Command Signal. The Zero control is for the low end input (min. output) adjustments while the Span Control is used for the high end input (max. output).

The Zero control has both the negative and positive voltage available making it usable as a manual or zero control. By turning the control clockwise, the output will increase proportionally to the adjustment. Turning it counter-clockwise will decrease or zero the output.

The Span control is used to adjust the maximum desired output. It will adjust for either a remote manual control or a command signal input. Clockwise adjustment increases the output while counter-clockwise adjustment decreases the output.

3-2 COMMAND INDICATOR

The Command Indicator is a green Light Emitting Diode (LED) located on the front cover of the unit. The brilliance of this LED will change with the Command Signal. The brilliance increases with an increased Command Signal and decreases with a decreased Command Signal.

3-3 ISOLATED AND NON-ISOLATED INPUTS

The RF1 has the capability of having either an isolated or non-isolated Command Signal input. It will always be shipped with an isolated input unless specified otherwise (known exception is a Manual Control input.) The standard input impedance is 500 ohms for isolated and 1500 ohms for non-isolated.

On units equipped with DIP switches, select “isolated” position for a 4-20ma command signal and “non-isolated” for a voltage input such as 0-10Vdc. Units without the DIP switch requires moving jumpers J3 and J4 as indicated on the firing circuit with an “I” or “N”.

The isolated input works best with an offset Command Signal such as 4-20ma; however, it will work with both offset and zero based Command Signals. Zero based Command Signals may have a small amount of non-linearity (input to output) at the low end. This should not be a problem on closed loop systems.

3-4 REMOTE MANUAL CONTROL

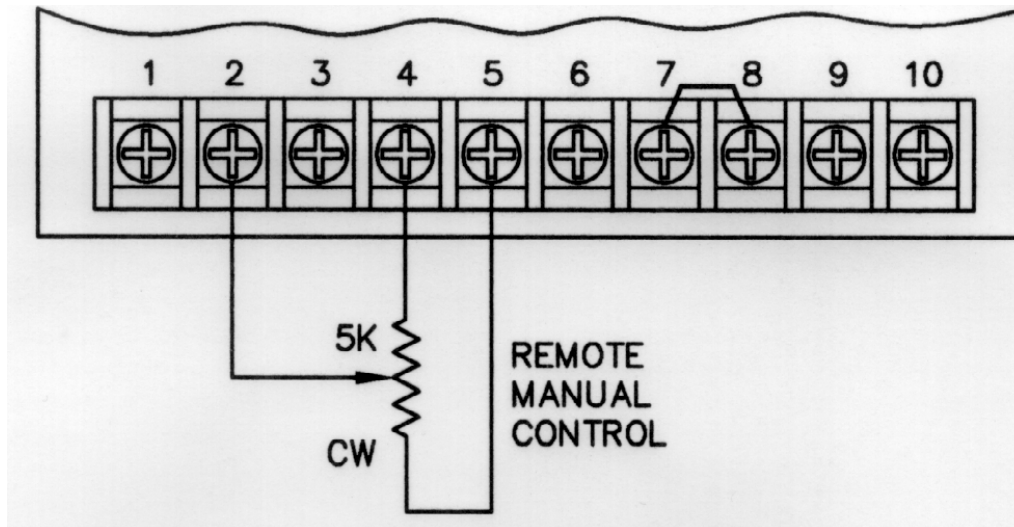
Some applications only require a manual control input and not a closed loop input from a process controller. The RF1 is designed to accept a remote manual control input (refer to Figure 6 for connections.)

Adjustments are simple and quick, but first verify that the firing circuit is set up for non-isolated input and that R31 has been removed. Next start with the Remote Manual Control in the zero (counter-clockwise) position, apply power to the Power Control. Adjust the Zero Control so the Power Control's output just starts to come on, then adjust it counter-clockwise so the unit's output is at zero. Now adjust the Remote Manual Control to the full output (clockwise) position, and adjust the Span Control until the maximum desired output is reached. This procedure may have to be repeated due to some interaction between the Zero and Span controls.

Figure 6
REMOTE MANUAL CONTROL

NOTE: Use RMS voltmeter to monitor output voltage.
A load must be present when making adjustments.

3-5 PROCESS COMMAND SIGNAL

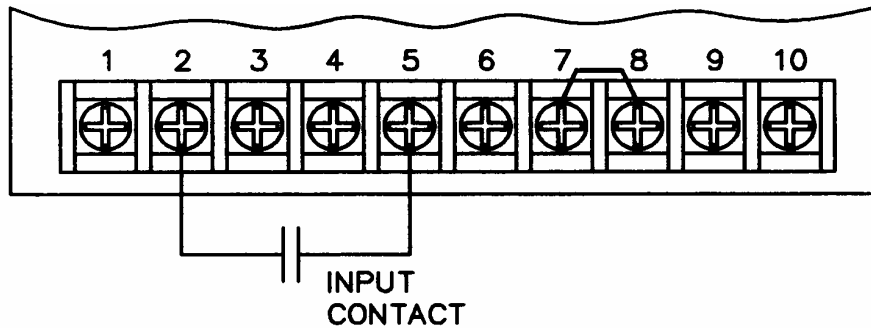


Process command signals can be either offset or zero based as discussed earlier. Simply connect the command signal to terminals 1 (-) and 2 (+) on the firing circuit and adjust the Zero and Span controls. Adjustments are easy. Simply have the process controller's output set at minimum and adjust the Zero control so the unit's output is at zero. Next have the process controller's output set at maximum and adjust the Span control for the maximum desired output. As with the Remote Manual Control, some interaction between controls does exist so repeating this procedure may be necessary.

3-6 ON/OFF CONTROL

Some applications require that a simple ON/OFF type control be used. The RF1 can be used for these simple applications. It can be connected for turn on by a contact closure. For on/off control, wire the contact according to figure 7. Once the wiring is complete, turn on the input power. Set the input contact to open and adjust the Zero control clockwise until the unit comes on, then adjust counter-clockwise until the unit just shuts off. Now set the input contact to the closed position and adjust the Span control clockwise until the unit's output is at the desired maximum output level. Repeating of this procedure may be necessary due to some interaction between the Zero and Span controls.

Figure 7
ON/OFF CONTROL



3-7 SHUTDOWN (DISABLE)

When it is necessary to shutdown or disable the output, it is a simple matter. Connect a dry contact closure between terminals 3 and 4 of the firing circuit. When it is closed, the power control will be shut off.

3-8 EXTERNAL FEEDBACK

An external feedback (0-10 VDC) is connected to terminals 4(-) and 9 (+). Ensure DIP Switch "FB" is in the "off" position when using an external feedback.



Section 4 - OVERCURRENT TRIP CALIBRATION

NOTE: The Zero and Span Controls should be adjusted prior to adjusting the O/C trip.

NOTE: All current transformers are shipped loose.

4-1 OVERCURRENT TRIP (OC)

The overcurrent trip adjustment is on the front of the unit. It's adjustment range is from 25 to 200% of the current transformer's current rating. It trips based upon peak current not RMS current as many others do.

If adjustment is necessary, have the command signal set at maximum and adjust the overcurrent trip control as necessary until the unit shuts off. Re-adjust the control clockwise until the unit will operate properly.

Another feature of the overcurrent trip is an automatic reset. Open the unit and locate the auto reset switch and reset pushbutton. With this switch in the on position, the unit will continue to reset until the fault clears. If in the off position, the unit will remain shut off until the local or remote reset PB is pushed. The auto reset switch will always be in the off position unless specified on the order.

The overcurrent trip includes a Form C relay output and provisions for a remote overcurrent reset PB. The relay output terminals are 35 and 36 for the N.C. and 36 and 37 for the N.O. The remote reset PB connects to terminals 33 and 34.

Section 5 - MAINTENANCE

5-1 ENVIRONMENTAL CONCERNS

Always verify that the RF1 is mounted in a clean, dust free environment. Clean the heat sink and printed circuit board periodically so no dust and/or dirt accumulates on the unit. Dust and/or dirt on the heat sink fins can prevent proper airflow causing overheating of the semiconductors. Conductive dust and/or dirt can cause shorts or arcing, which can cause damage to the unit.

Always size your enclosure so that a 50 °C maximum internal ambient temperature is never exceeded.

5-2 LINE/LOAD POWER CONNECTIONS

Periodically turn the power off to the RF1 and check for corrosion and tightness of the power connections. If any corrosion is evident, clean the cable and connector and reconnect making sure to tighten according to our torque specifications in Table 2.

5-3 STATIC PRECAUTIONS WHEN SERVICING

When servicing the Firing Circuit or option Printed Circuit Board (PCB), damage can occur due to static electricity. Always use a wrist strap grounded through a 1 megohm resistor. Transport the PCB in a static shielding bag. Caution in handling the PCB can help prevent any further damage to the PCB.

If you are not familiar with static precautions, consult the factory for additional details.

5-4 TROUBLESHOOTING TYPICAL SYMPTOMS

Any one of the following symptoms usually indicate a problem with the RF1:

1. No output regardless of the input.
2. Full output regardless of the input.
3. Output is not variable from 0 to full.

Refer to Table 3 for help in troubleshooting. If you cannot diagnose the problem, call AMETEK HDR's Service Department.

Table 4
Troubleshooting the RF1

<u>Symptom</u>	<u>Cause</u>	<u>Solution</u>
1	Open Fuse	Disconnect power and check the fuse. Replace if faulty. If not, contact the factory.
2	Shorted SCR	Disconnect power and check the SCRs. Measure the resistance across each pair of SCRs and the resistance should be infinite in both directions. If a short is indicated, replace the defective SCR or return the unit to the factory. No feedback will cause this also.
3	Defective Firing Ckt.	Disconnect power and unplug the Firing Circuit. Order a replacement Firing Circuit or return the unit to the factory.

WARNING
Always disconnect the source prior to attempting any servicing.

Section 6 - SERVICE AND SPARE PARTS

6-1 CUSTOMER SERVICE

If you have operational problems which cannot be resolved using this manual, please contact the Service Department at AMETEK HDR. Our normal work hours are 8 a.m. to 5:00 p.m., U.S.A. EASTERN TIME ZONE, Monday through Friday.

TELEPHONE: 1-888-PWR-CNTL (797-2685) OR 614-308-5500.

Our answering machine at 614-308-5500 will answer after hours and we will return your call the next working day.

FAX: 614-308-5506. 24 hours per day automatic answering.

6-2 SPARE PARTS

Inside Sales should be contacted for any spare parts orders whether routine or emergency during normal working hours. All after hours requirements should be called in on our 614-308-5500 answering machine. Please have as much information available as possible pertaining to the model number, serial number, order number and parts required. A purchase order number should be available.

RECOMMENDED SPARE PARTS : MODEL “ RF1 ”, 60-225 Amps, SCR
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	30 & 60 Amp	120 Amp	225 Amp
SCR	6791114	6791114	6722114
FIRING CIRCUIT	2099160	2099160	2099160
SNUBBER CIRCUIT	2099000	2099000	2099000
120V FAN	N/A	4520001	4520001
240V FAN	N/A	4500014	4500014

WARRANTY

AMETEK HDR warrants that the equipment delivered will be free from defects in workmanship and material for a period of five years from the date of shipment. AMETEK HDR will repair or replace, at AMETEK HDR's option, any part found defective during proper and normal use, provided that written notice of the nature of the defect is received by AMETEK HDR within the five year warranty period and that the customer returns the part to AMETEK HDR freight paid both ways. This warranty is not transferable by the initial end user.

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