RFC-2/70H DualBand Amp

Operator's Manual

High-Power, Dual-Band Power Amplifier for 2 meters and 70 centimeters

rfconcepts

a division of Kantronics Co., Inc.

Additional Product Information

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Written and printed in the U.S.A.

Your comments about this manual and about your experience with **rf**concepts products and services are invited.

CONTENTS

SECTION ONE – GETTING STARTED

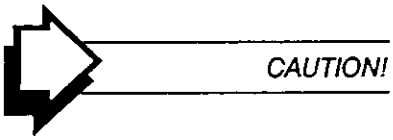
SECTION TWO – TECHNICAL REFERENCE

S E C T I O N O N E

Getting Started

1 *SAFETY FIRST!*

Any electronic device has certain dangers. Amplifiers, due to their nature and job of building power, create many hazards for uninformed or careless users. For your safety and the safety of others, it is absolutely critical that you read, understand and follow all the cautions and warnings in this section.



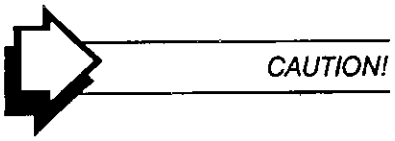
CAUTION!

■ *DO NOT TOUCH OR CLOSELY APPROACH ANTENNAS IN USE*

Radio Frequency Burns

Amplified radio frequency signals can cause extremely severe burns if you come very near to, or in contact with, an antenna during transmission. This is particularly true at 200 watts! The operator does not have to be talking into the transceiver. Simply keying or inadvertantly bumping the mic will generate a signal capable of severely shocking and of burning you. Mount antennas away from the potential of being accidentally touched or approached by children. Make sure all power has been disconnected before working on or touching an antenna.

Use of an amplifier requires you, the operator, to review the specifications of your antenna. Check the rating of your antenna to see that it is capable of handling an output of 200 watts.

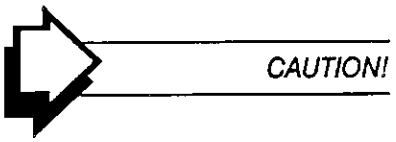


■ *MAKE SURE ANTENNA USED IS RATED FOR 200 WATTS*

Adequate Antenna Rating

Review the specifications of the antenna(s) you intend to use with your DualBand Amp™. Refer to the original documentation on the antenna product. The antenna must be rated for a minimum of 200 watts output. Check for special instructions or recommendations regarding high output power use. Do not use antennas not rated, or insufficiently rated. Discontinue use if signs of excess heat or abnormal conditions occur.

When installing the amplifier for mobile operation, it is important to provide external fusing and grounding for protection of the unit and to help guard against conditions that could lead to fire or to being shocked. The operator is responsible for those steps, and a qualified automotive radio installation service should be able to perform that installation for you, or to provide good quality fuses and wires for the job.

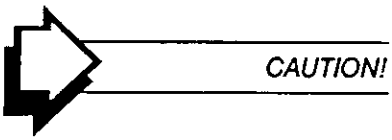


■ *PROPER FUSING AND GROUNDING IS IMPORTANT*

Fusing at the Battery

Mobile installation requires fusing at the automobile battery. Use high-quality fuses and wires for this important step. Refer to the section of this manual on installation for general wiring assistance. A qualified automotive or commercial radio/stereo installer should be able to perform this installation, or provide quality parts for the job. If you are not qualified, hire a reputable service to perform a safe installation for you.

During operation, make sure the amplifier cover is on and secured to the chasis. When the cover is off, the temperature sensing circuitry is rendered ineffective, and exposed circuitry can produce shocks.



CAUTION!

■ *KEEP COVER CLOSED AND SECURED DURING USE*

Cover Required for Safety

Thermal-protection circuitry depends on your DualBand Amp™ cover being in place for proper operation. When open, that circuitry does not sense temperature correctly, and the unit is exposed to the potential of overheating damage. The cover also protects the unit from damage by conductive items falling onto circuitry and helps to protect the operator and others from shock potential.

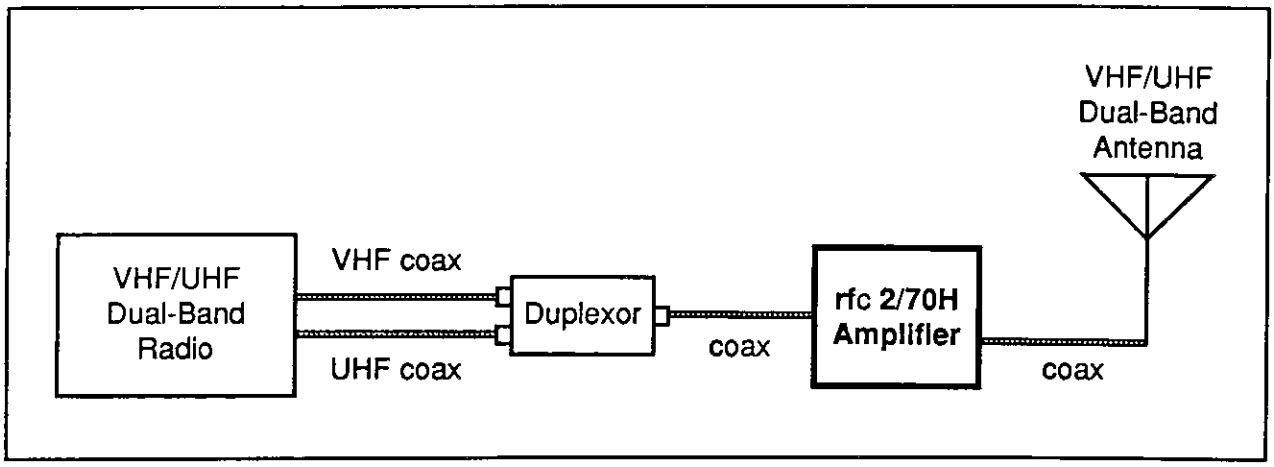
2 *Introduction*

With the introduction of many dual-band transceivers for VHF/UHF to the amateur service, it became clear that rfconcepts ought to offer a high-power dual-band amplifier. As it turned out, this became a substantial project for us and a very enjoyable one. The result is the high-power RFC-2/70H DualBand Amp™.

Most transceivers now on the market present up to 50 watts of drive with optional low-power output. Earlier units presented from 20 to 40 watts of output. Most have two antenna connectors, one for VHF and one for UHF (2 meters and 70 cm). In most cases the connector is an SO-239 but sometimes an N-type.

With this market trend toward dual-band transceivers, antenna manufacturers have also had to design dual-band antennas and in some cases to increase power handling capabilities. At present the typical dualband antenna has one coaxial connector, either PL-259 or an N-type male. Power ratings for those antennas rank from 50 watts to over 200 watts.

Consequently, owners of the new dual-band transceivers have had to resort to purchasing a duplexer in order to interconnect the two antenna connectors of the transceiver to the one connection of the antenna. Various duplexer models and brands are now readily available at your favorite amateur radio store or by mail order. The typical installation of a dual-band radio is shown in the figure on the following page.



Typical Amplifier Installation

When you install the RFC-2/70H DualBand Amp, it is simply placed between the output of the duplexer and your antenna. More detail on this follows in Section 5.

A Brief Look at Your DualBand Amp

You'll note that the amplifier has two controls and a number of status LEDs on the front panel. In addition it has two power terminals and the radio and antenna connectors on the back panel. Installation will require care and a 13.8 VDC, 40 amp high-quality power supply. Quick installation is not recommended. Please take the time to read this manual fully and to be safe. Two hundred watts at 144 MHz can burn!

The **rf**concepts DualBand Amp provides the added punch for your base station or mobile dual-band radio when needed. Automatic sensing circuits detect transmitted frequency and switch the proper output filter in line, providing 200 watts output on 2 meters or 125 watts on 70 cm with as little as 20 watts input. The amplifier automatically maintains a near-constant power output for input powers ranging from 20 to 50 watts. With that input range, the amplifier is perfect for use with almost all mobile dual-band radios on the market today. The new SineSink™ heat sink insures adequate heat dissipation for long life and low maintenance. The SineSink alone weights over 6 pounds! An LED bargraph displays relative output or reflected power. An SWR LED flashes to indicate high antenna VSWR, and the thermal LED indicates high temperature shutdown. Further specifications are listed in Section 6.

3 Panel Controls

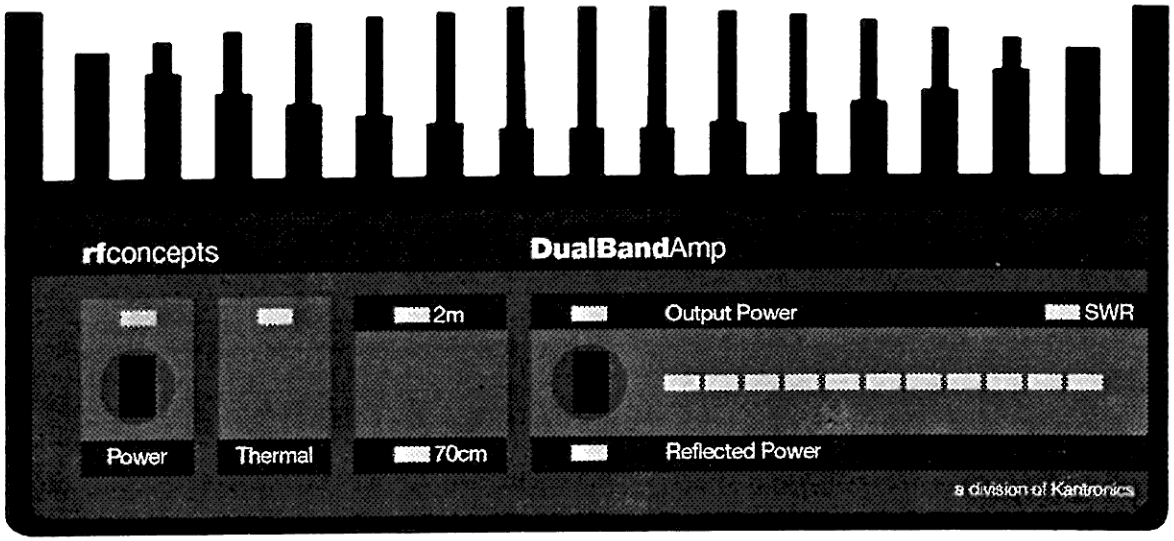
Several advanced features and controls are available at your fingertips with the DualBand Amp.

POWER BUTTON and LED

When pressed to the *in* position, power is supplied to the control sections of the unit. The LED above the button is lighted when the unit is on.

THERMAL INDICATOR

When the unit overheats, the Thermal LED will light. This indicates that the heat sink and air within the unit have reached the specified limit of about 130° F, 55° C. The amplifier shuts down when the thermal limit is reached. After the unit cools to about 126° F, or 53° C, it will re-key again when drive is applied.



75% Actual Size

RFC-2/70H DualBand Amp Front Panel

CAUTION

■ *DO NOT TOUCH HEAT SINK WHEN THERMAL LIGHT IS ON*

Overheat Temperature Can Burn

The temperature of the SineSink™ at overload is just about hot enough to cause burns. Resist the temptation to check the temperature with your hand until the unit has cooled for several minutes. It is good practice not to touch the SineSink™ during operation.

BAND INDICATORS

Frequency band LEDs are provided for 2 meters and 70 cm. The discriminator within the DualBand Amp automatically detects transceiver driving frequency and switches the proper low-pass filter in line at the output. The band LEDs indicate the band choice made by the circuit.

RELATIVE POWER BARGRAPH

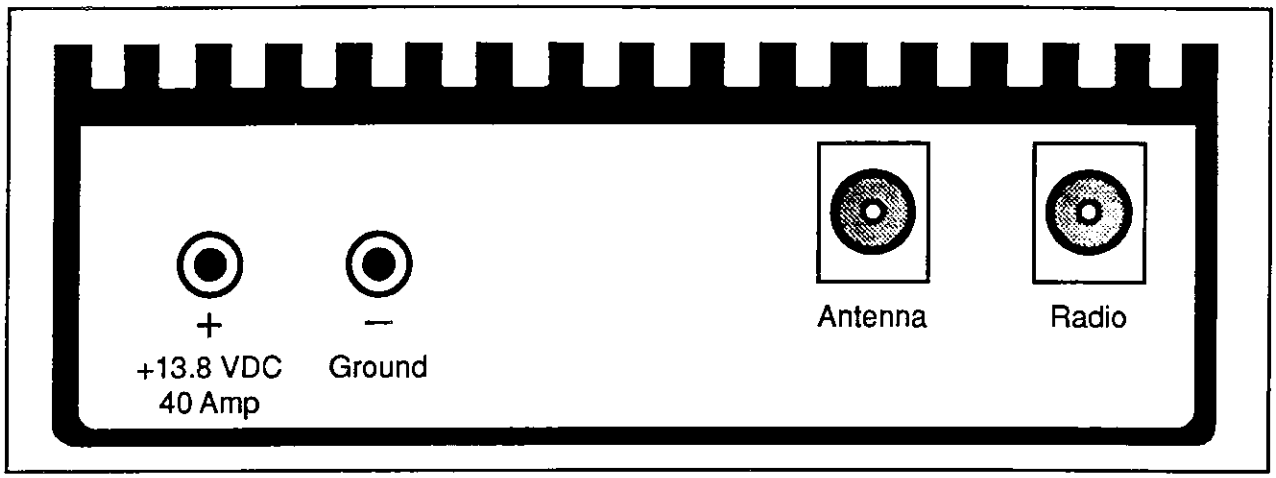
The LED bargraph indicates output or reflected power, and the individual Output and Reflected LEDs tell you which power reading is being displayed. This reading is taken at the amplifier output.

OUTPUT/REFLECTED BUTTON

Sets the bargraph to read Output (forward) or Reflected power. Push to the *in* position to read Output power.

SWR LED INDICATOR

The SWR LED flashes when the VSWR at the antenna terminal is greater than 1.5:1. Ratios greater than 1.5:1 will cause the unit to shut down and should not be exceeded. The RFC-2/70H DualBand Amp should be switched to the *off* position during impedance matching. That procedure takes the amplifier's circuitry out of the matching process, which is necessary for a correct reading. Your VSWR meter should be placed in line *after* the amplifier. Once SWR has been brought within tolerance, the amplifier will operate correctly once power has been restored.



RFC-2/70H DualBand Amp Back Panel

Back Panel Connections

POWER CONNECTORS

Your RFC-2/70H DualBand Amp is shipped with two pieces of 10-gauge power cable. The cables have eyelets on one end for attaching to the power terminals on the back of the unit. Attach the red (+) wire to the terminal at the far left. That is the 13.8 VDC, 40-amp terminal. Attach the black wire to the next terminal to the right. That is the (-), or ground, terminal.

ANTENNA CONNECTOR

This connector, which is situated nearest the center, is an N-type and accepts the coaxial cable leading to your antenna. An N-type was selected for best operation on 70 cm. The VSWR of your antenna must be less than 1.5:1, or the amplifier will switch off to protect the power FET package. To check your VSWR, the amplifier should be switched to the *off* position, so its circuitry is not involved during impedance matching.

RADIO CONNECTOR

This connector, an N-type, accepts the coaxial cable from your transceiver. It is at the far right of the back panel. The power input range expected is 20 to 50 watts.

4 *Installation*

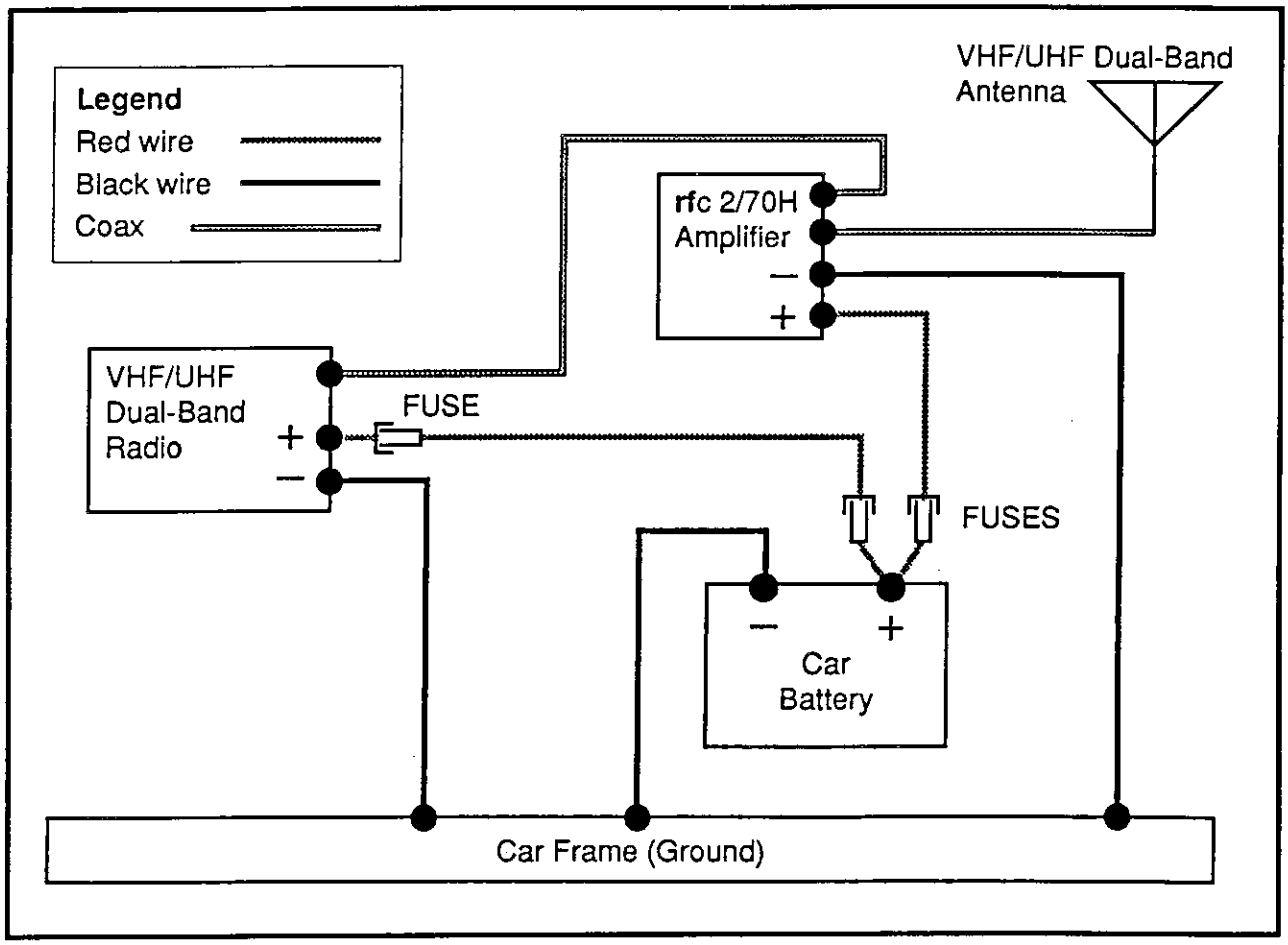
For both fixed and mobile installation, it is important to assure a good impedance match between transceiver and antenna. With the amplifier in line *but turned off*, the circuit is in a normally open mode. That means the signal from transmitter to antenna is fed directly through without being modified (in any significant way) by the amplifier. Leave the amplifier turned to the *off* position.

A VSWR meter should then be inserted in-line after the amplifier, and before the antenna. With the amplifier still off, test and match signals from near the center of both the 2 meter and 70 cm bands for as low an SWR as possible, but of *no more than* 1.5:1. For impedance matching instructions, refer to your transceiver and antenna manuals.

Your RFC-2/70H DualBand Amp will automatically shut down if it senses an SWR of 1.5:1 or greater. The SWR circuit protects components from being damaged by reflected signal energy coming back into your amplifier from a poorly matched antenna.

Power

A well-regulated, 12-13.8 VDC power supply is required. The amplifier will draw up to 40 amps, so the power supply should be rated to exceed that amount. With the supply off, attach the power cables supplied with your amplifier to the power supply. If you substitute cables, use at least 10-gauge wire for lengths of five to six feet and 8-gauge wire for installations up to 10 feet. Note and follow the



Mobile Installation Block Diagram

polarization color-coding on the power cables; black = (-) negative, red = (+) positive. Attach the cable terminals to the marked connectors on the back of the amplifier.

Fixed-Location Installation

Follow the general instructions on impedance matching and power attachment in this section. A well-regulated, fused power supply with short-circuit protection is recommended. Avoid excess length in the supply leads and locate the power supply near the amplifier to decrease the length of wiring necessary.

Mobile Installation

Follow the general instructions on impedance matching and power attachment in this section. For mobile installation, special fusing

and grounding are required for safe mobile operation. Additional fusing at the battery is highly recommended. A 60-amp automotive fuse is already provided internally with your RFC-2/70H for protection at the amplifier end of the cable, but that does not preclude the need for fusing near the battery. Grounding of the radio, amplifier and battery to the car frame are also safety measures you or a qualified automotive radio installation service will want to take.

The car battery should already be grounded. Assure that it is by following the wiring from the negative battery terminal to car-frame ground. Make sure the connecting lug is firmly attached and in good condition at both ends. After mounting the radio and amplifier, run cables utilizing 8-gauge wire and install 60-amp fusing protection as outlined in the Mobile Installation Block Diagram.

SEE PAGE 20 FOR MOBILE INSTALLATION DIAGRAM

5 Basic Operation

Assuming the RFC-2/70H is cabled to a dual-band transceiver, dual-band antenna and a quality 40-amp 13.8 VDC supply, you are now ready to operate.

Operation without the Amplifier

If the station you wish to communicate with is nearby, then there is no point in turning the amplifier on. With the Power button in the out or *off* position, you can operate as you normally would without any other steps. Because the amplifier is off, you will see no lighted LEDs. The power from your transceiver will simply *loop through* the normally closed relay points of the amplifier and proceed straight to the antenna basically unchanged. Your DualBand Amp will act as a closed switch between the transceiver and antenna you are using.

Operation with the Amplifier

When extra power is desirable, turn your RFC-2/70H on by pushing the Power button to the *in* position. When you key your microphone, the power from your transceiver will automatically engage the amplifier. The RFC-2/70H will automatically sense which band you have selected and will amplify that signal by configuring the output filters accordingly.

If the transceiver generates 2-meter signals, the 2m LED will light, and the Reflected Power can be displayed on the LED Relative Power bargraph. Press the Relative Power button to the *in* position to see a representation of Output Power, or leave it set to the *out* position to

see Reflected Power represented. It is important to note that the bargraph indicates relative power rather than specific power levels. When input power of 20 watts is applied to either band, the bargraph will be lighted fully across, or nearly so. Additional input power above 20 watts therefore, is not indicated.

Assuming your antenna is well matched, you should see only one or two LEDs on the bargraph lighted when the Reflected Power mode is selected and 20 watts of input power has been applied. More information about the bargraph is included in Section 3, Panel Controls.

If you transmit for long periods, the RFC-2/70H may reach *thermal shut-down*. That means you will lose amplification, and the Thermal LED will light. You can do that by keying the microphone for too long during one transmission, or by transmitting over half the time during extended conversations. In either event, the amplifier will overheat causing special circuitry to protect it from damage by shutting the unit down until it cools sufficiently. When the amplifier is ready for use again, the Thermal LED will turn off. More information on thermal shut-down is provided in both Section 3, Panel Controls, and in Appendix A, About your RFC-2/70H Amplifier.

Antenna Use

If you are using an outside antenna, operating mobile or even sometimes when using an inside antenna, it may happen that your antenna match will change during operation. That condition can occur when objects are placed near the antenna or when you move near objects during mobile operation. If the *impedance match,* the quality of the circuit tuning between your transceiver and antenna, deteriorates to less than 1.5:1, you will see the SWR LED begin to pulse on and off as you attempt to transmit. The amplifier will in that case, turn itself off to protect the power FET. Once the antenna is again matched at less than 1.5:1, you can resume using the amplifier after turning it off and then on again.

6 *Technical Specifications*

Freq. Range/Output Power	200 watts — 144-148 MHz
+/- 1 dB (approx. 20%)	125 watts — 438-450 MHz
International Model	200 watts — 144-146 MHz
	125 watts — 430-440 MHz
Input	20-50 watts
Duty cycle	50% intermittent use - **Not for repeater service.**
Current Requirements	40 amps @ 13.8 VDC
Voltage Requirements	12-15 VDC, 13.8 nominal
Power Cable Required	10-gauge up to 6'/2m
	8-gauge up to 10'/3m
Antenna Requirements	Must be able to withstand 200 watts. Dual-band required. Do not use on-glass antenna.
Size	8" x 12" x 4" (204mm x 305mm x 102mm)
Weight	11 lb (5.0 kg)
Connectors	Radio and Antenna single, N-type
Fuse	Internal 60 amp automotive-type fuse. Recommend installation of a second 60-amp fuse near the battery for mobile use.

7 *Warranty Information*

Your **rf**concepts 2/70H amplifier is covered by the standard Kantronics Co., Inc. Limited Warranty. As you may have noted on the cover page, **rf**concepts is a wholly owned division of Kantronics; hence, warranty and service are provided by Kantronics.

In addition to the standard Limited Warranty, Kantronics does not warrant the 2/70H for repeater service. If you use this amplifier in repeater service, the warranty is void, and the unit could fail or over heat repeatedly.

NOTICE!

■ *NOT FOR REPEATER USE*

Duty Cycle Not for Repeater Use

Use of this product in repeater service voids its warranty.

KANTRONICS CO., INC.

LIMITED WARRANTY

To be sure you will receive notice of future updates, new product information and prompt warranty service, please take a moment to fill in the Kantronics/rfconcepts Warranty Registration card COMPLETELY and return it along with a copy of proof of purchase (to establish purchase date) to Kantronics Co., Inc., 1202 East 23rd Street, Lawrence, Kansas 66046 USA. **Return of the Warranty Registration card and proof of purchase is a pre-condition to warranty coverage.**

1. **WARRANTY.** Kantronics Co., Inc. ("Kantronics") warrants to the first consumer purchaser ("you"), for the Applicable Warranty Period (as described below), that the Applicable Product (as described below) will be free from defects in material and workmanship.

2. **REMEDY.** Kantronics agrees that, for any Applicable Product found by Kantronics to be in violation of the warranty of Section 1 hereof within the Applicable Warranty Period, it will, at its option, repair or replace the defective Applicable Product at no charge to you, excluding in-bound shipping charges.

3. **EXCLUSIVE REMEDY.** Repair or replacement of the Applicable Product, as provided herein, is the sole remedy available to you against Kantronics, and in no event will Kantronics be responsible for any other liability or damages or for incidental, special, or consequential damages, regardless of whether purported liability is predicated upon negligence, strict tort, contract, or other products liability theory and whether or not Kantronics is warned about the possibility of such liability or damages. **SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.**

4. **DISCLAIMER.** The Limited Warranty is in lieu of all other warranties expressed or implied and no representative or person is

authorized to assume for Kantronics any other liability in connection with the sale of its products. KANTRONICS SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTY OF MERCHANTABILITY AND IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE FOR ANY APPLICABLE PRODUCT. IF, HOWEVER, YOU ARE A CONSUMER, WITHIN THE MEANING OF U.S.C. § 2301(3), THE ABOVE DISCLAIMER OF IMPLIED WARRANTIES IS EFFECTIVE ONLY FOR PERIODS OUTSIDE THE APPLICABLE WARRANTY PERIOD. **SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.**

5. **APPLICABLE PRODUCTS AND PERIODS.** Kantronics products are of two types - (1) hardware units and (2) firmware and software for operation of these units, whether incorporated into the units themselves or separate from the units as adjuncts or accessories to the units. Hardware units and the media containing firmware, software and documentation are sold to the consumer purchaser and become property of the purchaser. Firmware and software are licensed for use by the consumer purchaser in return for a fee included in the purchase price of the units and do *not* become the property of the consumer. (See separate License Agreement provided with these products.) The products to which the warranty of Section 1 hereof applies (herein "Applicable Products") and the periods during which the warranty shall apply to such products (herein, "Applicable Warranty Period") are as follows:

Applicable Product	Applicable Warranty Period
UNITS: KAM, KPC-2, KPC-3, KPC-4, Data Engine, DVR2-2, D4-10, KTU, rfc 2/70, rfc 2/70G, rfc 2/70H, rfc 2-23, rfc 2-217, rfc 2-117, rfc 2-317, rfc 2-417, rfc 4-32, rfc 4-110, rfc 4-310, rfc 3-22, rfc 3-211, rfc 3-112, rfc 3-312	One (1) year from date of purchase.

Applicable Product	Applicable Warranty Period
ACCESSORIES: Anemometer, Rain Gauge, Temperature Sensor (for KTU units)	Sixty (60) days from date of purchase.
DE1200 modem, DE19K2/9K6 modem, DE Jumper Board, MSK modem, Watchdog Timer	One (1) year from date of purchase.
MEDIA: EPROMS, diskettes, video or audio cassettes, manuals (however bound), specification and other supplemental pages or any other media on which firmware, software or documentation are supplied.	Thirty (30) days from date of purchase

6. **EXCLUSIONS.** This Limited Warranty does not apply to the cosmetic appearance of the Applicable Product; to broken or cracked cabinets; to any accessory not supplied by Kantronics which is used with the Applicable Product; to any product that has been subject to misuse, abuse or overvoltage; to any product that has been modified by non-Kantronics personnel, unless specifically authorized *in writing* by Kantronics; or to any product damaged or impaired by shipping (whether or not caused by poor packaging), neglect, accident, wiring not installed by Kantronics, improper parameter settings which are cleared by performing a hard reset, or use in violation of instructions furnished by Kantronics or generally accepted industry practice. Kantronics does not warrant that the functions contained in any software will meet your requirements or achieve your intended results; or that operation of any software will be uninterrupted or error-free or without effect upon other software used with it. Responsibility for the selection of the hardware and software program to achieve your intended results rests with you.

7. **REMEDY PROCEDURE.** Should you need to make a warranty claim, first contact the dealer from whom you purchased the product. If the dealer is unable to assist you, contact Kantronics Co., Inc., by

mail at 1202 East 23rd Street, Lawrence Kansas 66046 USA; by fax at 913-842-2021; or by phone at our Customer Support number 913-842-4476. Contact us prior to returning an Applicable Product to receive a Return Authorization Number. (As a practical matter, problems can often be solved in such a manner without the product having to be returned to Kantronics for repair or replacement.)

Return of any Applicable Product for the enforcement of rights under this Limited Warranty shall be at your expense. Any product returned for warranty service which Kantronics determines to be without defect or not covered by this Limited Warranty shall be subject to a minimum charge of one-half hour labor rate and the product will be returned to you at your sole expense. **Please note,** no warranty service will be provided until Kantronics has been furnished with your Warranty Registration card and copy of proof of purchase establishing purchase date.

8. **NON-ASSIGNMENT.** This Limited Warranty is not assignable by you. Any attempt to assign or transfer any of the rights, duties, or obligations hereof is void.

9. **OTHER RIGHTS. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.**

8 *Parts List*

Reference	Part Name	Reference	Part Name
C1	470PF_C0G	C31	8.2PF_C0G
C2	470PF_C0G	C32	470PF_C0G
C3	470PF_C0G	C33	.1UF
C4	470PF_C0G	C34	30PF_MINI_CHIP
C5	470PF_C0G	C35	4.7PF_C0G
C6	.001UF	C36	.1UF
C7	100PF_SMCMVTH	C37	30PF_SMCMVTH
C8	100PF_SMCMVTH	C38	.001UF
C9	.001UF	C39	.001UF
C10	SPRG_GXE10011	C40	30PF_SMCMVTH
C11	SPRG_GXE10011	C41	470PF_C0G
C12	.1UF	C42	.001UF
C13	470PF_C0G	C43	470PF_C0G
C14	.1UF	C44	22PF_SMCMVTH
C15	SPRG_GXE10011	C45	22PF_SMCMVTH
C16	500PF_LMCMHTH	C46	.001UF
C17	500PF_LMCMHTH	C47	3.3PF_C0G
C18	470PF_C0G	C48	470PF_C0G
C19	470PF_C0G	C49	15PF_SMCMVTH
C20	.1UF	C50	22PF_SMCMVTH
C21	470PF_C0G	C51	.001UF
C22	.0047UF	C52	SPRG_GXE10011
C23	3.3PF_C0G	C53	22PF_MINI_CHIP
C24	.1UF	C54	22PF_MINI_CHIP
C25	.001UF	C55	22UF_AL
C26	.01UF	C56	40PF_SMCMVTH
C27	1UF_AL	C57	.1UF
C28	.1UF	C58	1UF_AL
C29	470PF_C0G	C59	22UF_AL
C30	470PF_C0G	C60	.001UF

Reference	Part Name	Reference	Part Name
C61	.001UF	D2	1N914
C62	SPRG_GXE10011	D3	1N6263
C63	220UF_AL_16V	D4	1N914
C64	27PF_SMCMVTH	D5	1N914
C65	.001UF	D6	1N6263
C66	1UF_AL	D7	1N914
C67	470PF_C0G	D8	Y_LED
C68	150PF_SMCMVTH	D9	1N6263
C69	1UF_AL	D10	1N6263
C70	470PF_C0G	D11	1N914
C71	500PF_LMCMHTH	D12	Y_LED
C72	500PF_LMCMHTH	D13	Y_LED
C73	220UF_AL_35V	D14	1N914
C74	SPRG_GXE10011	D15	MR750
C75	.1UF	D16	1N914
C76	150PF_SMCMVTH	D17	1N914
C77	47PF_SMCMVTH	D18	1N4740A
C78	47PF_SMCMVTH	D19	1N914
C79	1UF_AL	D20	1N914
C80	150PF_SMCMVTH	D21	1N914
C81	.027UF_X7R	D22	1N914
C82	470PF_C0G	D23	1N4740A
C83	SPRG_GXE10011	D24	FEP30BP
C84	470PF_C0G	D25	1N914
C85	.027UF_X7R	D26	Y_LED
C86	1800UF_50V	D27	Y_LED
C87	1800UF_50V	D28	Y_LED
C88	.1UF	D29	Y_LED
C89	.1UF	D30	1N6263
C90	1800UF_50V	D31	MT208-5Y
C91	.01UF_5%	D32	MT208-5Y
C92	10UF_AL_50V	D33	1N914
C93	1UF_AL	D34	1N914
C94	15PF_MICA	F1	LTLFS_MAX060
C95	470PF_C0G	J1	N-CONNECTOR
C96	470PF_C0G	J2	2P_SIH
C97	470PF_C0G	J3	N-CONNECTOR
C98	10UF_AL_50V	J4	JUMP2
C99	.01UF	J5	BST11209TD318RA
C100	470PF_C0G	J6	2P_SIH
C101	10UF_AL_50V	J7	BCS112LDPE
C102	.01UF	J8	TSW11221TD
C103	.1UF	J9	BCS112LDPE
C104	470PF_C0G	J10	3P_SIH
C105	470PF_C0G	JMT1	SO-239_MTG_BLK
C106	470PF_1206	JMT3	SO-239_MTG_BLK
C107	470PF_1206	L1	0.47UH_CHOKE
C108	2.4PF_MUD	L2	2T_#18_.375
D1	1N914	L3	CCFT_164-04A06S

Reference	Part Name	Reference	Part Name
L4	0.47UH_CHOKE	R19	68K_1/8W
L5	.12UH_CHOKE	R20	27K_1/8W
L6	0.47UH_CHOKE	R21	220K_1/8W
L7	0.47UH_CHOKE	R22	4.7K_1/8W
L8	CCFT_164-03A06S	R23	10K_BRNS3386C
L9	CCFT_164-03A06	R24	330_1/8W
L10	2T_#12_.5D_SIL	R25	100
L11	2T_#12_.625D	R26	47K_1/8W
L12	2T_#18_.375	R27	75_2W_MT
L13	0.47UH_CHOKE	R28	75_2W_MT
L14	2T_#14_.5D	R29	75_2W_MT
L15	100T_#26_ECORE	R30	75_2W_MT
L16	11T_#16_ECORE	R31	47K_1/8W
LP1	1T_#14_.312D	R32	1K_BRNS3299W
LP2	2T_#14_.312D	R33	1K_X5_SIP
Q1	PN2222	R34	220
Q2	PN2222	R35	68K_1/8W
Q3	PN2222	R36	10K_1/8W
Q4	PN2907A	R37	10K_1/8W
Q5	PN2907A	R38	10K_1/8W
Q6	MRF175GU	R39	51_1/8W
Q8	PN2907A	R40	75_2W_MT
Q9	IRFP044	R41	75_2W_MT
Q10	PN2907A	R42	75_2W_MT
Q11	PN2907A	R43	75_2W_MT
Q12	IRFP044	R44	47_3W_WW
Q13	IRFP044	R45	47_3W_WW
Q14	PN2907A	R47	10K_BRNS3386C
Q15	PN2222	R48	1K_1/8W
Q16	PN2222	R49	62
Q17	PN2222	R50	1K_X5_SIP
R1	47.5K_1%	R51	56
R2	22.1K_1%	R53	100K_1/8W
R3	51K_1/8W	R54	10K_1/8W
R4	22K_1/8W	R55	47K_1/8W
R5	10K_1/8W	R57	56
R6	47.5K_1%	R58	10K_1/8W
R7	22K_1/8W	R59	33K_1/8W
R8	47K_1/8W	R60	56
R9	9.1K_1/8W	R61	47K_1/8W
R10	12K_1/8W	R62	10K_1/8W
R11	47K_1/8W	R63	100K_1/8W
R12	390K_1/8W	R64	1K
R13	22.1K_1%	R65	10K_1/8W
R14	75_2W_MT	R66	2.2_1/2W
R15	75_2W_MT	R67	1K_1/8W
R16	75_2W_MT	R68	39_2W_MT
R17	75_2W_MT	R69	39_2W_MT
R18	22.1K_1%	R70	56

Reference	Part Name
R71	56
R72	1.5K
R73	100_1/8W
R74	1K_1/8W
R75	1K_1/8W
R76	3K_1/8W
R77	100_1/2W
R78	10K_1/8W
R79	5.6K
R80	464_1%
R81	464_1%
R82	464_1%
R83	10K_1/8W
R84	464_1%
R85	464_1%
R86	33_1/8W
R87	464_1%
R88	390_1/8W
R89	1K_1/8W
R90	7.5K_1/8W
R91	150K_1/8W
R92	10K_1/8W
R93	1.5K_1/8W
R94	100K
R98	10K_1/8W
R100	1K_X5_SIP
R101	1K_X5_SIP
R103	10K_BRNS3386C
RGC1	UT141-50
RGC2	UT141-25
RGC3	UT141-25
RGC4	UT141-25
RGC5	UT141-25
RGC6	UT141-50
RL1	GRD_1365_DPDT
RL2	GRD_1365_DPDT
SL1	MIMET_H818-1012
SL2	MIMET_H818-1012
SL3	MIMET_H818-1012
SL4	MIMET_H818-1012
SL5	MIMET_H818-1012
SL6	MIMET_H818-1012
SLPD1	ALSP_SILPAD
SLPD2	TO-3P_SILPAD
SLPD3	TO-3P_SILPAD
SLPD4	TO-3P_SILPAD
SPCR1	.3125_NYL_SPCR
SPCR2	.3125_NYL_SPCR
SPCR3	.3125_NYL_SPCR

Reference	Part Name
SW1	ITTS_FL\T_DPDT
SW2	ITTS_FL\T_DPDT
T1	BIGA_XFMR
TS1	LM34DZ
U1	LM339
U2	LM358
U3	4011/
U4	4001/
U5	LTC1044
U6	TL594CN
U7	NE555
U8	LM3916
VR1	LM78L08C
VR2	LM7812

REVISION RECORD			
LTR	ECO NO:	APPROVED	DATE:

12V/28V OPTION

12V-60A
28V-30A

12V/28V OPTION

DISPLAY BOARD

SWITCH BOARD

POWER SWITCH

FWD/RFLCT SWITCH

CONNECT AMMETER TO MEASURE QUIESCENT CURRENT, JUMPER TO OPERATE.

JUMPER TO SET QUIESCENT BIAS current/=200ma

JUMPER TO DISABLE REMOTE CONTROL

REMOTE CONTROL ON = SHORT

Kantronics

TITLE: DUAL BAND AMP

DRAWN: B. KERNS	DATED: 5/1/92	CODE:	SIZE: D	DRAWING NO:	REV: D
CHECKED:	DATED:				
QUALITY CONTROL:	DATED:				
RELEASED:	DATED:	SCALE:		SHEET: OF	

S E C T I O N T W O

Technical Reference

Because the use of products like your RFC-2/70H DualBand Amp provide both an operating *and* a learning experience, we have tried to assist in that process by developing a new *Learning Format* approach in this manual. If you are not already advanced in your understanding of radio and electronic principles, some of the information in this section – and throughout the manual – will assist you in becoming more knowledgeable about the theory of this product.

Your comments on this format and manual are encouraged. Please write to "Sales/Service" at the Kantronics address provided on page 2 of this manual.

A

About Your RFC-2/70H Amplifier

Directional Coupler

The rfconcepts DualBand Amp uses a directional coupler to sense transceiver drive power and thereby key itself on. Due to the coupler, only the power from your transmitter or transceiver is sensed. Signals from nearby transmitters picked up by the antenna are ignored. Thus, false keying is avoided.

The drive coupler output also discriminates between the 2-meter and 70-cm drive signals to configure *in* or *out* the 2-meter low-pass final filter. Drive output is also summed to activate the amplifier transfer relay. Closure of the relay(s) enables the internal 13.8 VDC to 28 VDC power supply, and only then does amplification on the correct band occur.

The internal 28 VDC switching power supply is necessary to obtain efficient operation of the amplifier's FETs. Regulation circuitry helps to greatly reduce any output power sag caused by a variation in supply voltage.

The RFC-2/70H takes advantage of recent advances in high-power UHF MOS FET technology. A single transistor is used to produce a 200-watt signal on 2 meters and a 125-watt signal on 70 cm. For band switching, a low-pass filter is inserted in the drain circuit of the FET.

The amplifier transistor used, a Motorola MRF175GU, is a push-pull field effect transistor pair contained in a single *Gemini* package. That new configuration increases your gain and power output by balancing the FET source currents within the transistor package. The effect is more efficient transfer of power, giving you a distinct advantage over older separate-package designs.

Push-Pull Design

The push-pull amplifier uses a total of six broad-band balun transformers. Those transformers are made from a short section of hard-line coaxial cable inserted through a magnetic core. The first balun changes the unbalanced 50-ohm RF drive to two unbalanced 25-ohm push-pull drives. Those sources are then transformed to two 6-ohm impedance push-pull drives. After additional impedance matching, the resulting signals are applied to the push-pull gates of the MRF175GU.

The matching process is reversed on the transistor output. The push-pull drains are first impedance-matched to 6 ohms and then transformed in the remaining three baluns to a 50-ohm output.

SWR

Separate forward and reflected directional couplers sense the amplifier power output and the load SWR. LED indicators tell you if you are viewing forward or reflected power. The forward coupler drives both the Automatic Load Control (ALC) circuit and an output power display to allow you to see a ten-LED graphic representation of the forward power. The ALC limits power output to 200 watts on 2 meters and 125 watts on 70 cm to help prevent overloading the amplifier.

The reflected power coupler drives the antenna SWR protection circuitry and the reflected power display. If SWR is too high, the amplifier automatically shuts down, and a special SWR LED is lighted to notify the operator. Ratios higher than 1.5:1 will cause shut down.

Once you have found and corrected the SWR problem, the SWR circuit can be reset by pushing the Power button to the *off* position and then back to the *on* position.

SWR Display

It is important to note that the forward and reflected power displays provide only a relative indication of power and are adjusted for the amplifier capability on each band. The display is compressed on the left end with the first LEDs indicating about 10 dB of change, and the final LEDs (right) indicating about 1 dB. The design is intended to provide better graphic representation of the forward and reflected powers.

How Hysteresis Protects Your Amplifier

In addition to SWR protection, your amplifier is also protected from thermal overload. Your RFC-2/70H DualBand Amp is designed to be used for a maximum of 50 percent duty cycle. This means you should be transmitting only about half the time, as would be the case during normal conversation. Part of the time the other operator will be transmitting, allowing your amplifier a rest cycle.

Lengthy transmissions at or exceeding the 50 percent duty cycle will cause the temperature of the amplifier to rise. When that condition occurs, special circuitry in your DualBand Amp senses the rise and will shut down amplification to help prevent damage. That shut down occurs at about 130° F, or 55° C. That temperature is also about at the point at which the SineSink™ becomes too hot to touch. So the thermal shut-down feature also helps reduce the possibility of burns from an over-heated unit. It is likely that during summer heat, the amplifier installed in an already hot trunk may operate well below 50 percent duty cycle.

Hysteresis is the effect of the previous history of a system on its response to a current external force or influence. Once thermal overload has been reached, the hysteresis circuitry keeps your RFC-2/70H shut down until it cools well below the shut-down temperature. The hysteresis circuitry will keep the amplifier in an *off* state until it has cooled 3° C. The Thermal overload LED will light during the shut-down period to inform the operator.

The SineSink™ Design

rfconcepts' unique SineSink™ represents a more efficient technology in heat dissipation and also greater artistic appeal. By concentrating a majority of the metal in a central mass (like a cube), heat is transferred quickly from the FETs to the mass. The new design's greater exposed surface area also helps dissipate that accumulated energy into the surrounding air more rapidly.

B Glossary

ALC

ALC is an abbreviation for automatic level control. The term is loosely used for many kinds of electronic circuit control. A familiar example of ALC is AVC, or automatic volume control. Your television and radio use AVC as a built-in feature. Once you set the volume with your remote control, or the knob on the television or radio, fluctuations in the received signals are smoothed out. The circuitry that smooths out the signal is referred to as the AVC circuitry. In that way, you don't notice signal changes. Within power amplifiers, ALC is used to regulate the power output of the amplifier by providing a constant output for a varying input power level.

Balanced Push-Pull

The term push-pull is common to audio amplifiers. Basically it defines how two transistors are combined together to form a power amplifier. RF amplifiers also make use of this push-pull arrangement. The special balanced push-pull design of the DualBand Amp™ yields inherently lower harmonic output. The FETs combined in a single *Gemini* package are connected so that their inputs are fed in phase opposition and their outputs are delivered alternately to a common load.

Directional Coupling

The term coupling implies the transfer of a signal or voltage from one point in a circuit to another. In most circuits, coupling can happen in either direction. However, by special design, a coupling circuit can be produced that will transfer a signal or voltage in only one direction. Hence the term *directional coupler.*

The RFC-2/70H uses three directional couplers. The purpose of the input coupler is to couple a control signal from your transceiver to key the amplifier. However, power reflected from a mismatched antenna comes back to your amplifier and transceiver from the the opposite direction. The coupler, and hence the keying circuit, does not see that signal because the coupler is forward-looking only, or *directional.* In that way, reflections from the antenna do not falsely key your amplifier. The remaining two couplers in the output of the amplifier are used for ALC control and VSWR detection.

Discriminator

A discriminator circuit is one that allows a response only to signals having certain special characteristics, in this case the proper frequencies to be amplified, either 2 meters or 70 cm.

Duplexer/Diplexer

A duplexer is a circuit that combines or separates signals from two different bands of frequencies. For example, most dual-band radios have two coaxial outputs, one for VHF and another for UHF (2 meters and 70 cm). A duplexer is then used to combine those two signals into a single connector for attachment to a dual-band antenna. In the case of the RFC-2/70H amplifier, a duplexer would be used to combine the signals from a dual-band radio for application to the single input of the RFC-2/70H DualBand Amp.

FET

Field Effect Transistors, or FETs, are solid state devices that behave much like tubes. The voltage or signal applied at the input, or gate, of an FET controls the current in its output. Power FETs are very suitable for RF amplification and are used as the main power devices in the RFC-2/70H.

Harmonic Output

Harmonics can occur at multiples of the input frequency as a result of non-linear amplification. Harmonic output can interfere with other radios tuned to any one of the harmonic frequencies, so they must be reduced through design. Harmonics exist because when an RF signal is amplified, it is impossible to maintain the signal shape perfectly unless amplification is perfect.

Hysteresis

Many mechanical systems you are familiar with have built-in controls referred to as hysteresis. The home thermostat is one example. If you set an inside temperature of 68 degrees during the winter, and the actual temperature in the room falls below 68 degrees, the furnace turns on. Once the room heats to above 68 degrees, the furnace turns off.

But that process creates a dilemma. Do we really want the thermostat to be that exact? If it is, then when the temperature reaches 68.001 degrees, the furnace turns off. When the temperature falls to 67.999, the furnace should turn on. The result would be a nearly constant on and off cycling of the furnace. The solution is to add hysteresis to the thermostat circuitry. By design then, a thermostat with a 68-degree setting would perhaps turn on when the temperature drops to 67 and would turn off again at 69.

Your RFC-2/70H DualBand Amp has hysteresis built into its temperature sensor. Once the amplifier's heat sink reaches 130° F, or 55° C,

the amplifier automatically switches off, and cannot be switched on again until a drop of two degrees occurs.

Normally Open/ Normally Closed

Both of these terms are used in regard to relays. The points of a relay can be either open or closed before power is applied, depending on its design. There are many uses for both types. For example, if the points of relay XYZ are normally closed, that means when power is applied to the control coil of the relay, its points open and break the circuit they are a part of.

Impedance Matching

Matching is the process of equalizing source impedance, such as that of a transmitter, to a load impedance, such as an antenna. Antennas must be adjusted to match 50 ohms, the standard output impedance of VHF and UHF transmitters.

If the antenna is not properly matched, RF power will be reflected back into the transmitter. That energy can reduce transmitter output or cause failures. The 2/70H detects reflections that are above a VSWR of 1.5:1 and shuts off. The amplifier will not key again until the mismatch is corrected and it is turned off and then back on.

RF Burns

RF burns are burns caused by contact or sometimes near-contact with high-power signals being radiated from an antenna or circuit at radio frequencies. Amplified RF signals from approachable antennas present a safety hazard, and steps should be taken to minimize the possibility of contact with them during transmission.

SEE SECTION 1, SAFETY FIRST!

SineSink™

The design of the RFC-2/70H DualBand Amp heat sink is unique. The new design allows more surface area for cooling and has angles specially designed for superior dissipation of heat and for artistic appeal.

SWR

SWR, or standing wave ratio, is used as a measure of quality in many signal transmission systems. For example, it may be used to measure the impedance match between an antenna and the output of a transceiver. Generally SWR is measured as a voltage standing wave ratio, or VSWR. In that case the VSWR would be defined as the ratio of the voltage traveling from the transmitter to the voltage reflected back from the antenna. Those voltages must be measured by a VSWR meter, *not* a volt-ohm meter, or VOM. VSWR meters are built utilizing directional couplers so that voltages traveling in separate directions can be measured. The RFC-2/70H has a built-in coupler that is used to measure the VSWR at its output with an antenna attached. Hence the circuitry has the capability of shutting down the transmitter if the antenna has too high a VSWR – meaning the antenna impedance does not match the output impedance of the amplifier. A high VSWR can damage the amplifier if power is maintained, and the VSWR remains high. That is why shut-down protection is provided in your RFC-2/70H.

SWR Shutdown

Circuitry in your DualBand Amp™ senses the output VSWR during transmission and automatically disengages the amplifier from the system when it senses a ratio of 1.5:1 or greater.

Thermal Shut-Down

Protective circuitry senses the inner air temperature and SineSink™ temperature of your DualBand Amp and automatically shuts the unit down if 55° C is reached. This protects the unit from heat damage and helps to protect the operator from the potential for burns. Thermal shut-down can be caused by operation in excess of the unit's 50 percent duty cycle.

C

Support Services Available to You

When service or repairs appear necessary, it may save you time and money to call or write to **rf**concepts to determine if the problem can be solved without returning your unit. Customers outside the USA, see also Section D, Additional International Support.

Telephone Support Services

Your amplifier is backed by a knowledgeable technical staff available on the Kantronics/**rf**concepts Amateur Radio Service Line.

Amateur Radio Service Department: (913) 842-4476

Hours of operation: 9 am-noon and 2 pm-5 pm Central Time, Monday through Friday.

If these times are not convenient: Write to us at the address on page two of this manual, or send us a brief note by facsimile at (913) 842-2021, or by computer at our BBS, (913) 842-4678.

When contacting us by telephone, be sure to call the service line, (913-842-4476, and have the following available:

- *the product name,*
- *your unit's serial number,*
- *date of purchase, and*
- *your name, callsign, address and daytime telephone number*

Return/Repair Procedures

Consult the Limited Warranty Information, Section 7, for the service provisions offered by Kantronics/**rf**concepts at *no charge*. The limited warranty is considered to be in force only when the customer has submitted the completed warranty registration within ten days of purchase, and when the stipulations of the warranty have been met. Violations of the warranty clauses will automatically void the warranty, and service or repairs will be charged to the owner.

NOTICE!

■ *RETURN AUTHORIZATION REQUIRED*

Obtain Return Authorization Number

To avoid a minimum labor charge, **even if your unit is under warranty,** *any unit returned for repair must receive a Return Authorization Number. That number is obtained through the Amateur Radio Service Department.*

Service outside the warranty period will be charged at the cost of parts, labor and return shipping. **Units returned for service without a Return Authorization Number will be subject to a minimum charge of 1/2 hour labor plus shipping and handling.** . Repaired units will be returned by UPS C.O.D. UPS handling charges can be avoided by including your VISA or MasterCard credit card number and expiration date with your unit. Shipping and repair will be charged upon completion.

D

Additional International Support

International Returns

In case of unit problems, first contact the dealer from whom you purchased the product. If you must return a Kantronics/**rf**concepts product to us, please observe the steps outlined below. It will save both you, the customer, and Kantronics/**rf**concepts unnecessary difficulties and expense.

1. All returns must be shipped to the factory at 1202 East 23rd Street, Lawrence, KS 66046 USA.

2. All expenses of returning item(s) to Kantronics/**rf**concepts must be paid by you, including any duty/entry fees, whether the return is for warranty or non-warranty repair.

3. Usually, the best way to return item(s) to us is by mail. However, if you wish to use one of the courier services such as DHL, Federal Express, etc., be sure to use **DOOR-TO-DOOR** service. If you use one of these services, a commercial invoice may be required. Please check with your carrier before shipping.

4. Include in the description of the item(s) on the paperwork (whether postal or courier) the words "U.S. GOODS RETURNED FOR REPAIR/REPLACEMENT." An *additional* description of "Amateur

radio peripheral equipment," or "Data communications equipment," would be helpful. It would also be helpful (but not required) to include the code number 9801.00.1035 9 which tells U.S. Customs agents that the package contains "U.S. goods returned without improvement/enhancement." However, if the words "U.S. goods returned for repair/replacement" are on the paperwork, the number is not really necessary.

5. Provide a value for customs purposes. This is usually the value of the item(s) in their current condition. A $0 value is not acceptable for U.S. Customs.

6. Inside the package, with the item(s), include:

- *a correct and full address for return,*
- *payment,*
- *a brief description of the problem,*
- *a reference to any conversations with the technical/sales staff about the problem,*
- *and the Return Authorization number which has been assigned.*

7. For warranty repairs, we will pay the shipping charges to return the item(s) to you via **air parcel post**. If you wish return by courier service, include your account number. To be eligible for repair under warranty, we must have a record that you sent your Warranty Registration card and proof of purchase to Kantronics/**rf**concepts, and the item(s) must still be within the warranty period at the time the return is authorized.

8. For non-warranty repairs, you must pay the return shipping charges.