

ACOM700S

HF + 6 m LINEAR AMPLIFIER



OPERATING MANUAL

TABLE OF CONTENTS

1.	GENERAL INFORMATION	3
1-1.	Introduction and description.....	3
1-2.	Owner assistance	3
1-3.	Equipment supplied and options.....	3
1-4.	Features.....	4
1-5.	Safety considerations, explicit definitions	4
2.	INSTALLATION	5
2-1.	Unpacking and Initial Inspection	5
2-2.	Amplifier operating location selection; cooling.....	6
2-3.	Connecting the amplifier within the shack	6
2-4.	Installing options and connecting to external devices, computer, etc.	9
3.	POWERING AND OPERATION.....	10
3-1.	Low energy stand-by mode of the power supply	10
3-2.	Front panel - controls and indication.....	10
3-3.	Initial turning on	11
3-4.	Basic screen	11
3-5.	Control system – buttons and menus	13
3-6.	Test transmission	13
4.	AMPLIFIER OPERATION	16
4-1.	Change of modes, RX / TX and Operate / Stand-by; option AUTO OPERATE	16
4-2.	Band change, standard and expanded frequency coverage	17
4-3.	Operation with an external antenna tuner.....	18
4-4.	Automatic protection system.....	18
5.	MENUS – SETTINGS AND OPTIONS	19
5-1.	Menu “Measurements in the amplifier” – AMP MEASURE	20
5-2.	Menu “Service functions in the amplifier” – AMP SERVICE.	21
5-3.	Menu CAT/AUX SETTINGS.....	21
5-4.	Menu “USER PREFERENCES”	23
5-5.	FAULTS LOG	24
5-6.	RESTORE DEFAULT SETTINGS.....	24
6.	REMOTE CONTROL	25
6-1.	General information	25
7.	MAINTENANCE.....	25
7-1.	Periodic maintenance; general checks and cleaning.....	25
7-2.	Replacement of fuses	27
7-3.	Using the fault codes (signatures) for diagnostics	27
7-4.	FIRMWARE UPDATES.....	28
8.	SPECIFICATIONS	28
8-1.	Parameters	28
8-2.	Functions	29
8-3.	Storage and shipment.....	29
9.	DISCLAIMER.....	29

1. GENERAL INFORMATION

1-1. Introduction and description

This manual describes the installation, operation, and maintenance of the HF+6m solid-state linear power amplifier ACOM 700S.

ACOM 700S is a state-of-the art linear amplifier, covering the amateur bands from 1.8 to 54MHz with 700W output power (PEP or continuous carrier) with less than 40W of drive. The amplifier operating information is shown on a multi-functional, high resolution color display. ACOM 700S may be controlled either by the six front panel buttons or remotely – via an RS232 port.

NOTE

ACOM 700S is designed to work with the ACOM 04AT Remote Automatic Antenna Tuner. The connection of ACOM04AT will make accessible the features that are inactive on the amplifier display when ACOM 700S operates without the ACOM 04AT. The operation of ACOM 700S with ACOM 04AT is described in the ACOM 04AT Operation manual.

1-2. Owner assistance

If technical or operating assistance is needed, please contact your local dealer first. In the unlikely case of you needing further information, you may get in touch with ACOM via: fax (+ 359 2 920 96 56), telephone (+359 2 9209780), e-mail (acom@acom-bg.com, acom@mail.orbitel.bg) or by post (6 Valeri Petrov str.,Bozhurishte 2227,Bulgaria). Website: www.acom-bg.com.

1-3. Equipment supplied and options

The amplifier is supplied in a single box including:

- amplifier ACOM 700S;
- this manual with a CE declaration of compliance;
- four pieces of spare fuses

1-4. Features

- 5" high resolution color display (108x65mm), 800x480 pixels, and 24-bit color.
- The final PA stage uses a rugged LDMOS transistor - MRFE6VP61K25N or equivalent.
- Compatible with all transceiver models available on the market - does not need any special signals: „ground on transmit“ and less than 40W of RF drive power is sufficient.
- Broadband input circuit, providing a perfect transceiver load with SWR below 1.2:1 (typically 1.1:1), without retuning throughout the whole frequency range from 1.8 to 54MHz.
- The overall operation of ACOM 700S is extremely simplified : the screen menus are intuitive and easy to follow, no special skill is required from the operator when changing frequency bands.

- Automatic control – when connected to a transceiver with CAT capability, the amplifier will track the operating frequency, and will change bands accordingly.
- Even if not CAT connected, the amplifier monitors the input signal frequency through the built-in frequency counter and automatically switches bands.
- Remotely controlled by RS232 port.
- Takes care of itself during operation via continuously working protection circuits in all modes.
- The operator can monitor more than 10 parameters of the amplifier in operation.
- Easy maintenance – detailed data (55 parameters) about each of the last 28 hard-fault protection trips is stored in the amplifier's non-volatile memory.
- Convenient for expeditions and field operation due to the extremely compact and lightweight construction and the built-in switching-mode power supply (SMPS) that operates with extended mains voltage range of 100-240VAC, with no internal switch over. The consumed current is purely sinusoidal, Power Factor Corrected (PFC) and inrush limited. This makes the operation from unstable mains and generators easy and troublefree.
- Perfect electromagnetic compatibility (EMC) with both highly sensitive devices and the powerful devices in the radio station (receivers, computers, other amplifiers) exceeding the standard EMC requirements due to the used PFC and built-in radio-frequency filters.

1-5. Safety considerations, explicit definitions

The ACOM 700S linear amplifier is a Class I apparatus regarding protection against electric shock, i.e. the third grounding lead of its mains cord (colored yellow with two green stripes) and the grounding stud on the rear panel, marked GND (Fig. 2-1), must be connected to the grounding system of the shack for safe operation.

The ACOM 700S amplifier is designed to meet international safety standards and complies with the CE electromagnetic compatibility requirements, as well as the FCC regulations.

This operating manual contains precautions, cautions, and warnings that **MUST BE COMPLIED TO** by the user to ensure safe operation and maintaining of the ACOM 700S amplifier in a safe working condition.

PRECAUTIONS:

The EXPLICIT DEFINITIONS described below apply to this operating manual:

WARNING notes call attention to a procedure which, if not correctly performed, could result in personal injury or fire hazard by electric shock or lightning.

CAUTION notes call attention to a procedure which, if not correctly performed, could result in equipment damage, not only in the ACOM 700S amplifier.

NOTE notes call attention to a procedure which, if not correctly performed, could result in inconvenience.

WARNING HIGH VOLTAGE!

Both the mains voltage and the high DC voltage up to 500V inside the ACOM 700S amplifier are LETHAL! For your safety, disconnect the power plug from the mains and WAIT AT LEAST three minutes EACH TIME, BEFORE removing the cover of the amplifier.

WARNING HIGH VOLTAGE!

NEVER ALLOW, ESPECIALLY CHILDREN, to insert anything into holes in the case - this may cause ELECTRIC SHOCK! Never touch an antenna or antenna isolators during transmission or tuning - this may result in an electric shock or burn. Never expose the amplifier to rain, snow or any liquids. Avoid placing the amplifier in excessively dusty environments or in direct sunlight. DO NOT OBSTRUCT COOLING ducts or vents.

WARNING

Do not undertake repairs or changes in hardware or firmware of your ACOM 700S amplifier. Doing so will endanger your or others' health or life, or damage the amplifier and the equipment connected to it. Such repairs or changes are not covered by the warranty and may void the warranty. The manufacturer is not liable for any such repairs or changes. Any such repairs or changes are the responsibility of the person or persons engaging in them.

CAUTION

To avoid damage (not covered by the warranty) please read the INSTALLATION - Section 2 of this operating manual carefully. If you have any doubts or questions regarding the installation, operation or safety of the ACOM 700S amplifier, please consult your dealer immediately.

2. INSTALLATION

2-1. Unpacking and Initial Inspection

CAUTION

Before you commence installing the ACOM 700S amplifier, please read this manual thoroughly. Carefully inspect the shipping carton and its contents as described below for missing items (S. 1-3) or mechanical damages. If anything is missing or is damaged (scratched, bent, crushed or something is rattling inside or moving freely when turning the amplifier over, **notify your dealer immediately!** Delaying this notification may infringe the warranty conditions of the carrier.

NOTE

Keep the original packing for possible future transportation.

Unpack and inspect carefully the contents of the cardboard carton for possible transportation damages. On the amplifier, check-up the chassis, front panel, display, buttons, rear panel connectors, main power switch and fuses.

2-2. Amplifier operating location selection; cooling.

Locate the amplifier close to the place where will be used. You will need an easy access to the rear panel for connecting cables, and of course, to the buttons and screen on the front panel.

The ACOM 700S is forced air cooled. Locate the amplifier so that there are no objects or other devices closer than 10cm (4"). The exhaust air can reach 65°C (150°F) and if the surrounding devices are sensitive to heating from outside or use forced air cooling themselves, increase the distances accordingly.

CAUTION

Do not leave free paper, cloth or other light materials around and under the amplifier. They may be drawn in by the cooling air stream and block the vents. This will lead to overheating and accelerated material aging, not covered by the warranty.

2-3. Connecting the amplifier in the shack

WARNING

Before you connect the amplifier to external grounding, you should advise with a licensed electrician and confirm such kind of connection is allowed by your national and local electrical code, safety rules, and regulations in force. Simultaneous connection to the earth grounding and protective earth may be inadmissible or may fall under special requirements in some countries!

WARNING

Never use the gas installation pipes for grounding. This can cause an EXPLOSION!

WARNING

Do not use the steam-heating or water-supply network pipes for grounding! You may expose to dangerous voltage not only yourself but also other people using the same installation.

CAUTION

Bear in mind that the grounding installation may have to withstand emergency currents over 15A with minimal voltage drop on it. Therefore it may be necessary to improve its conductivity using heavier leads and lower-resistance grounding path. The grounding lead should be at least 4mm² (AWG 11 or SWG 13).

For details and recommendations on the grounding and RF counterpoise system concerning the electromagnetic compatibility see also S. 3-6(f).

- a) GND stud - First connect the grounding stud of the amplifier (located on the rear panel and marked GND – Fig. 2-1) to the grounding system of the shack.

- b) KEY-IN jack - amplifier input for receive/transmit control from the transceiver.

The transceiver switches the amplifier from receive mode into transmit mode (RX/TX) by grounding of the KEY-IN input.

Run a shielded cable from the output of your transceiver, providing “ground on transmit”, to the KEY-IN input on the amplifier rear panel (RCA PHONO jack – Fig. 2-1). Use a standard RCA PHONO plug for connection to the amplifier.

Transceiver manufacturers give different names to this output, for example: TX-GND, SEND, T/R LINE, RELAY, and others. In some transceivers “ground on transmit” output should be activated by a menu or via changing a switch on the rear panel or inside the transceiver. See instructions in your transceiver manual.

NOTE

Voltage on the KEY-IN jack does not exceed 12V and the current is below 6mA. See also S. 8-2(a).

NOTE

Your amplifier will not work if the KEY-IN input is not connected correctly. If you experience any difficulty consult your dealer.

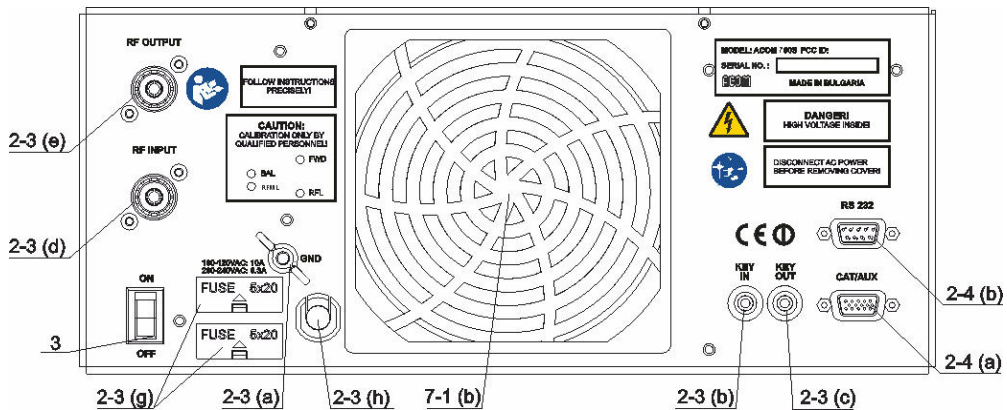


Fig. 2-1 Rear panel connections

- c) KEY-OUT jack - transmit-enabling control output from amplifier to the transceiver.

The KEY-OUT jack on the rear panel provides an extra control signal from the amplifier to the transceiver. This can be used for improving the receive/transmit (RX/TX) switching safety.

CAUTION

KEY-OUT is a low-powered open-collector output, make sure that the signal voltage coming from the respective transceiver connection does not exceed 50VDC (open circuit) and the closed-circuit current is below 20mA.

If your transceiver has a suitable input, that disables transmission unless grounded externally, we recommend this to be connected to the KEY-OUT jack of the amplifier. Use shielded cable terminated with a standard RCA PHONO plug.

ACOM 700S HF Linear Amplifier - Operation manual

The transceiver manufacturers give different names to this input, for example: TX-INHIBIT, MUTE, LINEAR, and others. Check the manual of your transceiver. Approach your dealer for details. If your transceiver has no such input, do not worry – ACOM 700S will operate normally with KEY-OUT unconnected.

- d) RF INPUT - Connect a coaxial cable with a PL-259 plug from the transceiver output (antenna jack) to the amplifier RF INPUT jack.

CAUTION

In order to avoid at damage, turn off your transceiver's internal antenna tuner.

- e) RF OUTPUT - Connect a suitable coaxial cable with a PL-259 plug from the RF OUTPUT on the rear amplifier panel to the antenna switch, tuner or antenna intended for the respective frequency band.

CAUTION

If you use an amplifier for the first time in your shack, pay serious attention to the size of coaxial cable from your amplifier output to the antenna. The cable must be capable of handling the increased power safely, particularly on the 10m and 6m bands. This warning applies equally for the antenna switch, tuner, and the whole antenna system, especially when using multi-band trap antennas.

We recommend using RG213 or better. Consult your local coax cable supplier.

- f) Preparation of the mains outlet for the amplifier, requirements for the installation and the mains voltage.

CAUTION

Before connecting your amplifier to the power grid, be sure that the outlet is correctly wired and is capable of providing the required current i.e. up to 10A from 200/240VAC mains. Also make sure that the grounding lead is connected properly in the outlet, intended for the amplifier. If subsequently you connect the amplifier to a different outlet, check it as well.

It is preferable to use the mains outlet closest to the source. Make sure that the respective fuses and voltage of your power mains match the ACOM 700S amplifier's specifications (see S. 8-1(g)).

- g) Main fuses.

CAUTION

Make sure you check whether the main fuses installed in your amplifier correspond to your local mains nominal voltage and if necessary replace them as described in Section 7-2!

- h) Power cord inlet. Due to different mains standards in different countries, the ACOM 700S is delivered without a power plug for the mains cable. You dealer might be able to provide the correct Safety Class I plug. The ground lead of the power cable is colored yellow with two green stripes. If you have any doubts about the correct way to connect these wires, consult your dealer.

2-4. Installing options and connecting to external devices (transceiver, computer, etc.)

- a) CAT/AUX interface – used for connecting and operating with various transceiver models (see table 2-1 below and the respective menu in S. 5-3, table 5-1 and Fig. 5-3).

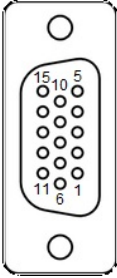
Most of the modern transceivers can be connected by CAT to the ACOM 700S. This will allow the amplifier to track the transceiver frequency without any transmission and change the bands automatically when in Operate mode. The cable can be supplied optionally, ordered separately or home brewed according to table 2-1 and the transceiver's manual.

The CAT connection requires a cable made especially for the ACOM 700S and your transceiver. Wiring diagrams of such cables can be found at www.acom-bg.com.

Note that some of the connections - to the transceiver's BCD band data outputs and Band Voltage outputs do not provide an exact frequency data, but only band data. Those connections cannot be used when ACOM 700S works together with ACOM 04AT because the tuner needs to know the exact frequency, not the band.

Table 2-1 shows the signals and the pin out of the CAT/AUX connector - rear panel of the amplifier.

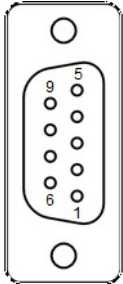
Table 2-1

CAT/AUX interface	PIN NO.	PIN NAME	DESCRIPTION	SPECIFICATIONS
 <p>Rear panel view</p>	1	RxD	Received Data	TTL input
	2	RxD	Received Data	RS232 input
	3	TxD	Transmitted Data	RS232 output
	4	TxD	Transmitted Data	TTL output
	5	GND	Ground	0 Volt
	6	BAND voltage	Analogue input	0 to +8V
	7	Band data 0	Bit 0	TTL input
	8	Band data 1	Bit 1	TTL input
	9	Band data 2	Bit 2	TTL input
	10	Band data 3	Bit 3	TTL input
	11	ON RMT	Remote Pwr On	+4.5 to + 15V / 3mA max
	12	Debug mode	CPU only Pwr Input	+8 to + 15V / 0.4A
	13	KEY-IN	Tx Request	Less than +12V / 6mA
	14	KEY-OUT	Tx Ready	O.C. output, up to +50V / 20mA
	15	GND	Ground	0 Volt

- b) RS232 port. Table 2-2 shows signals and pinout of the RS232 port on the amplifier's rear panel.

This connector may remain unused until you decide to control the amplifier remotely.

Table 2-2

RS 232 interface	PIN NO.	PIN NAME	DESCRIPTION	SPECIFICATIONS
 Rear panel view	1	-	Not connected	-
	2	TxD	Transmitted Data	RS232 level output
	3	RxD	Received Data	RS232 level input
	4	-	Not connected	-
	5	GND	Ground	0 Volt
	6	DSR	Remote Power On	RS232 level input
	7	-	Not connected	-
	8	CTS	Remote Power On	RS232 level input
	9	-	Not connected	-

3. INITIAL POWER ON AND OPERATION

CAUTION

Do not turn the amplifier on at least two hours after unpacking it and installing in its final operating position. Pay special attention whenever the amplifier is moved from a very cold place to a very warm one because condensation may develop on the inside resulting in damage to the high voltage circuits of the amplifier. Under these circumstances, do not turn the amplifier on for at least 4 hours. A similar effect could occur following a rapid warming of the room, such as winter usage of a powerful electric heater.

After following all instructions in Section 2 INSTALLATION, check whether the rear panel mains switch is turned off. Then plug the amplifier in the mains outlet.

3-1. Low energy standby mode of the power supply

Now you can turn on the mains switch on the rear panel. This will activate only the low-energy stand-by mode of the amplifier power supply and will light up the red LED above POWER button, while the main power supply is still off and the display is dark.

3-2. Front panel - controls and readouts

- POWER button. When the rear panel mains switch is turned on, push and hold 1-2 seconds to start the amplifier up. When the amplifier is turned on, push to turn it off (back to standby mode).
- LED indicator above the POWER button. When lit red and the screen is dark, the amplifier is in standby mode and may be turned on by pushing the POWER button.



Fig. 3-1 Front panel

- c) 6 functional buttons keypad for manual (local) control of the amplifier. The function of each button is indicated on the display above it. Depending on the displayed menu, the buttons may have different functions.
- d) A color display showing the operating information.

3-3. Initial switching on

In order to start up the amplifier, push and hold the POWER button on the front panel for one or two seconds- about ten seconds later (boot sequence) the display will flash and show the **basic screen** with the amplifier information - Fig. 3-2.

The amplifier may start either in Stand-by or in Operate mode – see S. 5-4 USER PREFERENCES - AUTO OPERATE.

3-4. Basic screen

There are 9 information areas on the basic screen:

- a) Information area for the frequency band – the edges of the currently selected BAND are displayed.

If the amplifier doesn't receive any operating frequency data from CAT or via RS232, it will switch to the last used band at startup.

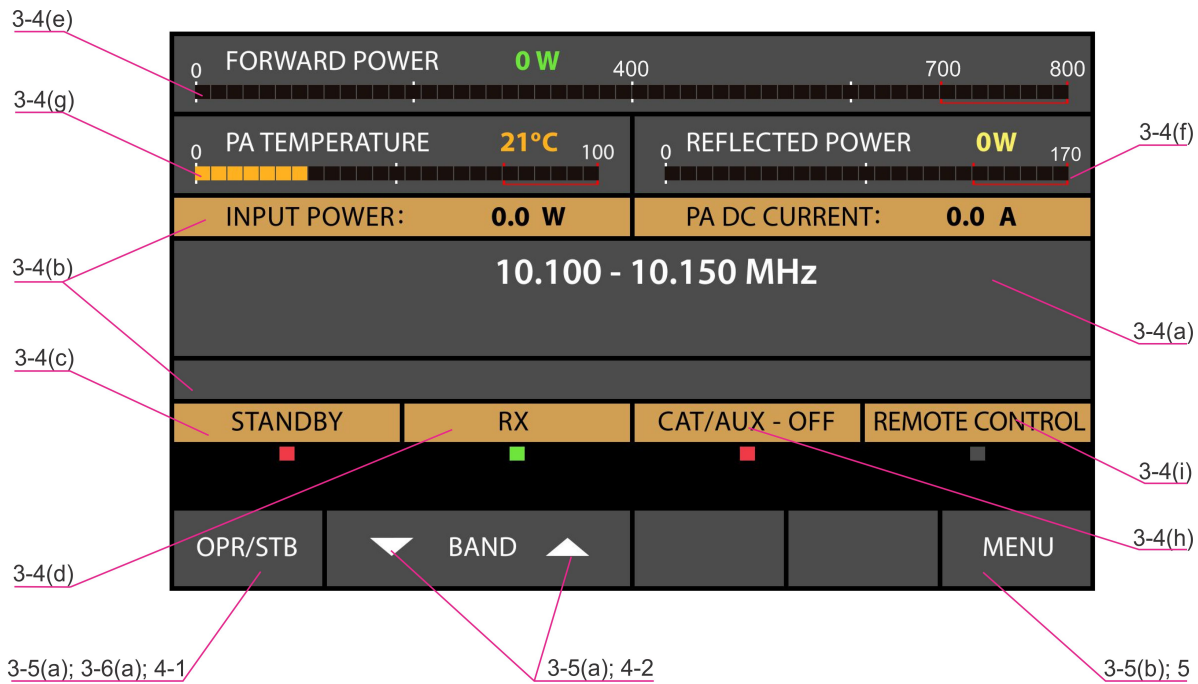


Fig. 3-2 Basic screen

b) Operating values and alarm messages area.

Any two operating values selected in the AMP MEASURE menu (S. 5-1) will be shown here.

The alarm messages (either WARNING or SOFT FAULT) appear on yellow background on the same area and are flashing frequently in order to attract the operator's attention (Fig. 4-1).

The WARNING messages appear only temporarily (for about three seconds), afterwards the indication of the operating values is restored automatically (S. 4-4(a)).

The SOFT FAULT messages appear in the same field but they remain on the screen until the AUTO OPERATE time is elapsed (S.4-1(c)) or until the operator pushes any button, then the operating values indication is restored too.

- c) Working mode indicator - OPR, STB or AUTO OPER (S. 4-1).
- d) RX/TX indicator - reads the request for transmit (KEY-IN input). The RX indication is green and the TX is red. The indicator will flash frequently if switch over is impossible.
- e) Forward power bargraph and digital readout. Displays the power fed into the antenna.
- f) Reflected power bargraph and readout. Entering the red zone is not allowed.
- g) PA transistor temperature bargraph and readout. Entering the red zone is not allowed.
- h) CAT interface information. When CAT is deactivated, this field is shaded.
- i) REMOTE CONTROL information field—flashing represents RS232 port dataflow.

3-5. Control system – buttons and menus

- a) The OPR/STB and the BAND buttons are used for manual (local) control of the (Fig. 3-2):
 - the left-most button OPR/STB switches over the amplifier between Operate and Stand-by modes;
 - the next two buttons – BAND up and down arrows - change the frequency bands in ascending or descending order;
- b) The right-most button MENU (Fig. 3-2) provides access to the amplifier's settings and service functions;
 - in each menu the left-most button is always HELP and the right-most – always EXIT;
 - the HELP button provides information about the current screen;

For more details of the control system and use of the menus see Section 5. MENUS – USEFUL TOOLS AND OPTIONS.

3-6. Test transmission

To make sure that you have installed the amplifier correctly, make a test transmission as described below. Repeat these tests for each new band and antenna, as well as after installing a new or repaired antenna, antenna switch, tuner, and / or the connecting cables.

- a) Check of RF by-pass path of a non-driven amplifier.

For this check the amplifier must be completely installed and connected according to Section 2, but not powered by the mains, i.e. the POWER ON switch on the rear panel must be turned off. In any case the LED above the POWER button must be dark for this test.

First, check if the transceiver's reception is normal. If you observe a significant worsening of reception, first check for a problem in the coaxial connections to the amplifier (S. 2-3(d),(e)).

If reception is normal, prepare the transceiver as follows:

- select a continuous carrier mode (CW, RTTY, FM);
- switch the microphone off (decrease the mic gain), disable FSK;
- reduce the output power control to a minimum;
- select a suitable indication so that you can watch the RF power and SWR at the transceiver output;
- if the transceiver has a built-in antenna tuner – switch it off.

Now in receive mode select a frequency which is not occupied at the moment and press shortly the PTT or TX key while watching the output power and the SWR readings. If the power or SWR at the transceiver output are too high (over 5W or SWR over 2:1) release the key and check for the reason as follows:

- check again whether the power control is set at minimum;
- check whether the frequency is within the operating range of the selected antenna;

- check the good working order of the coaxial cables, connectors, and feed lines from the transceiver antenna jack through the amplifier, the antenna switch or external tuner (if there is one) to the BALUN transformer, and the antenna itself (S. 2-3(e)).

If the power and SWR are as expected, transmit again and while watching the power and the SWR readings, increase transceiver power gradually from minimum to maximum (but not more than 170W in order to not overload the RF by-pass circuit of the amplifier).

If SWR remains below 2:1 (preferably below 1.5:1) at the last test, decrease the power from the transceiver to minimum again and continue with the next check-up.

- b) Check-up in Stand-by mode.

Turn the amplifier on, as described in Sections 3-1 to 3-4 (Fig. 3-2).

Make sure that the amplifier is in Stand-by mode. Push the OPR/STB button if needed.

Repeat receive and transmit tests as it was done with the amplifier turned off. During these tests note also whether the forward and reflected power bargraph and digital readout (S. 3.4(e),(f)) show respective RF power presence. If the reflected power exceeds the forward power, verify that the input and output coaxial cables to the amplifier are not interchanged (S. 2-3(d),(e)).

NOTE

The power indication accuracy is optimized around the 700W level and usually it is unreliable below 40W.

- c) Entering Operate mode.

At Operate mode the transceiver receiving should not suffer. If it worsens and together with this the indicator RX changes into TX although the transceiver is in receive mode, check the control cable connected to the KEY-IN input – S. 2-3(b) for a short circuit. The connection to the transceiver could be wrong too.

- d) Test transmission.

Switch to the same band as the transceiver and antenna.

Set the transceiver to a continuous carrier and minimum power. In Operate mode choose a free frequency and push the PTT or CW key briefly, while watching the amplifier's behavior:

- RX mode must have changed to TX;
- the reflected power must read below 20W;
- the forward power must read between 20 and 150W with minimum drive power from the transceiver (between 1 and 5W);

If the above test goes normally, push briefly the PTT once again, this time watching the transceiver's SWR reading (i.e. the input SWR of the amplifier) – this must be below 1.2:1.

- e) Setting of drive level and typical operation.

After the successful passing of the above tests push PTT or CW key for several seconds, watching the forward and reflected power. Increase the drive power until the forward power at the amplifier's output reaches 700W.

Upon reaching 700W forward power check the following parameters (continuous carrier operation):

- the reflected power must not exceed ~78W (for SWR 2:1) or better still to be below 28W (for SWR 1.5:1);
- PA DC CURRENT must be between 23 and 30A; it is normal that the current varies within these limits when changing operating frequency and antenna impedance;
- PA DC VOLTAGE must be within 42 – 44V;
- the transceiver's SWR reading must be below 1.2:1.

Enter the MEASURE menu and check:

- the drive power from the transceiver must be 35W +/- 1.55dB;
- PA BIAS, which must be between 2.4 and 2.8V;
- PA TEMPERATURE, which must be between the ambient and 95°C (203°F), depending on the power level and the duration of transmission.

f) Elimination of electromagnetic compatibility (EMC) problems.

If you use an amplifier for the first time in your shack, you may need to make some improvements in the setup. It is possible you might experience tingling from metallic objects due to the stronger radiated RF field. It could affect the operation of your station or systems outside, if they are too sensitive – typical examples are the microphone, CW keyer, computer keyboard / mouse, as well as TV receivers, Hi-Fi, intercom or telephone setups and others.

For instance, induction of RF currents into the microphone, CW keyer or computer keyboard, may lead to distortion in the peaks or self-oscillation in SSB mode, “sticking” or breaking off the dots or dashes from a Morse keyer, or garbling computer screen images. For the elimination of such problems we recommend that you take the following general measures:

- minimize the radiation from the feed lines by reducing the common mode currents in them, improve the balance of antennas and feedlines;
- in case you use asymmetric antennas (GP and similar) install as many radials as practical (use a well-developed counterpoise system);
- add current chokes on the coaxial feeders;
- place as far away as possible (also by height) the radiating elements of antennas from the premises, where the affected devices are located; in this sense, asymmetrical antennas without a separate feeder (Long Wire, Windom, and similar) may cause more interference because their radiating element begins immediately from the shack (part of it is the feeder itself);
- if the use of asymmetrical directly fed “wire” antennas is inevitable, use mainly half wave or half wave multiple – they have a high input impedance, operate respectively with a small current in the feed point, and in the grounding of the shack; thus you can reduce the strength of the disturbing RF fields more than 10 times (at the same radiated power) compared to the case with quarter-wave and multiple to quarter-wave antennas of this class – you should avoid them because they have a low input impedance and operate with a large RF current in the grounding system and in the power supply network respectively, i.e. they create stronger disturbances (RFI);

- improve the RF grounding system: use the shortest and widest possible metal strips for the connections to ground and between the different gear in the shack; connect one or more counterpoises (sized for the problematic band) to the feeder shield at the point, where it enters the building, and the same point - with the possibly shortest and widest connections - to the grounding system: this is a very efficient measure, in particular if the shack is located on a high floor above ground;
- to reduce the RF impedance of the grounding connections sheet metal stripes instead of flexible braids are preferred;
- thread ferrite beads or snap-in ferrites with medium permeability (800-4000) over the power cord, the feeder and the signal cables leading to the affected devices (TV etc); besides the size, consider the frequency range in which the offered ferrites are effective – normally they are optimized for suppression of interferences on HF (with larger permeability), with medium permeability for HF-VHF or with low permeability - only the VHF range. The latter are ineffective for HF;
- whenever possible use shielded cables and ground their shields at both ends;
- the addition of even quite simple low pass L/C or R/C filters directly to the disturbed inputs or outputs of the devices is very effective, provided it is practically applicable.

Last but not least, bear in mind that the benefit of the above measures is two-fold. Firstly - they reduce the interferences from your transmissions to the ambient environment and secondly - they reduce the background noise floor for your reception. Practically, with no great efforts, implementing the above measures, you can reduce the background noise floor with one or more S-units across the different bands. This will allow you not to miss weaker stations, which will hear you because of your increased transmission power.

4. AMPLIFIER OPERATION

4-1. Change of modes RX/TX and Operate/Stand-by; AUTO OPERATE option

- a) In **Stand-by** mode, as well as in the unpowered state, receiving and transmitting with the transceiver is done via RF bypass between RF INPUT and RF OUTPUT of the amplifier. In Standby, the transceiver's RF power is not amplified, the control KEY-IN input does not affect the operation, and the KEY-OUT output (S. 2-3(c)) follows the state of the KEY-IN input unconditionally. The bands cannot be changed neither manually nor by CAT or remotely.
- b) In **Operate** mode the receive-transmit (RX/TX) direction is controlled by the KEY-IN input:
 - at open KEY-IN (Operate/RX mode), the transceiver receives the signals from the antenna through the same RF by-pass path between RF INPUT and RF OUTPUT as with amplifier turned off or in Stand-by mode;
 - at grounded KEY-IN ((Operate/TX mode) the RF drive is amplified and fed to the antenna through the RF OUTPUT connector.

CAUTION

In order to provide time for the relays to switch safely from receive to transmit, the transceiver should provide a dead time i.e. must “notify” the amplifier in due time by grounding the control KEY IN input not later than 10ms **before** feeding drive power toward the amplifier RF input. Otherwise, the protection system will read “HOT SWITCHING ATTEMPT” and will trip off.

In Operate mode the KEY OUT output (S. 2-3(c)) follows the state of the KEY-IN input only after all conditions for safe transmission have been found good by the amplifier control unit. The KEY OUT output duly disables transmission, if the amplifier is not ready.

The two modes - **Operate** and **Stand-by** - may alternatively be changed:

- either manually (locally) – by pressing the OPR/STB button – see the basic screen in Fig. 3-2, or automatically – when if the AUTO OPERATE option is activated – see S. 5-4(c).

NOTE

Access to the Operate mode can be locked in the AMP SERVICE menu, the OPERATE ACCESS option (S. 5-2 and Fig. 5-2).

- c) **AUTO OPERATE** option can be turned on/off by the operator in the USER PREFERENCES menu – S. 5-4 and Fig. 5-4 - or by a remote control command.

When the AUTO OPERATE option is OFF, the two modes Operate and Stand-by can be changed alternatively by the OPR/STB button or by a remote control command. At a SOFT FAULT protection trip, the amplifier will revert to Stand-by and wait for the operator to return it to Operate by pressing the OPR/STB button.

When AUTO OPERATE is ON (S. 5-4), the amplifier will start up in Operate mode. At a SOFT FAULT protection trip, the amplifier will first revert to Stand-by, but will return automatically to Operate mode in about 4 seconds.

Even at AUTO OPERATE on, the operator can revert to and remain in a Stand-by mode manually by the OPR/STB button or by a remote command. The next OPR/STB button push will switch the amplifier to the Operate mode and restore the normal operation of the AUTO OPERATE option.

4-2. Band change, standard and expanded frequency coverage

When connected to a transceiver with CAT, the amplifier will change frequency bands automatically, following the transceiver’s operating frequency changes.

Without CAT connection, the bands can be changed either manually or automatically (by the built-in frequency counter).

The bands are changed manually by the up and down BAND buttons.

For an automatic band change via the built-in frequency counter, make a quite short pre-transmission (100ms is enough) – a CW dit, or a sound on SSB) and release a PTT for a moment before the main transmission.

If the new frequency is out of the amplifier’s frequency range (S. 8-1(a)), the transmission request will be denied and the following fault message will appear on the screen:

“FREQUENCY OUT OF RANGE”

The amplifier specifications are guaranteed within the bands listed in S. 8-1(a)). Frequency coverage changes could be negotiated with the manufacturer.

4-3. Operation with an external antenna tuner

At antenna SWR over 1.5:1, it is advisable you use an external tuner. The ACOM 04AT Remote Automatic Antenna Tuner is designed to work with the ACOM 700S. Use of other antenna tuners is not recommended.

4-4. Automatic protection system

The control unit (S. 7-3(b)) keeps track of most amplifier analogue and logic signals in all modes. Those are the receive/transmit control signal, the output relay contact state and switching times, the RF drive frequency and drive power (the input power), the final transistors DC current and DC voltage on the drains as well as, the gates bias voltage and the heat sink temperature, the main power supply components temperature, the RF output forward and reflected power, and others. Some derivative parameters, as the power gain, the SWR, the heat power dissipated by the final transistors dynamically and others, are watched too.

In the event a parameter maximum is exceeded, the amplifier will assess the risk and will trigger one of the three levels of protection, as described in items (a) to (c) below. Every event is accompanied by a warning text on the screen (Fig. 4-1). A sound alarm will be also produced, if set on in the “USER PREFERENCES”– fig. 5-4.

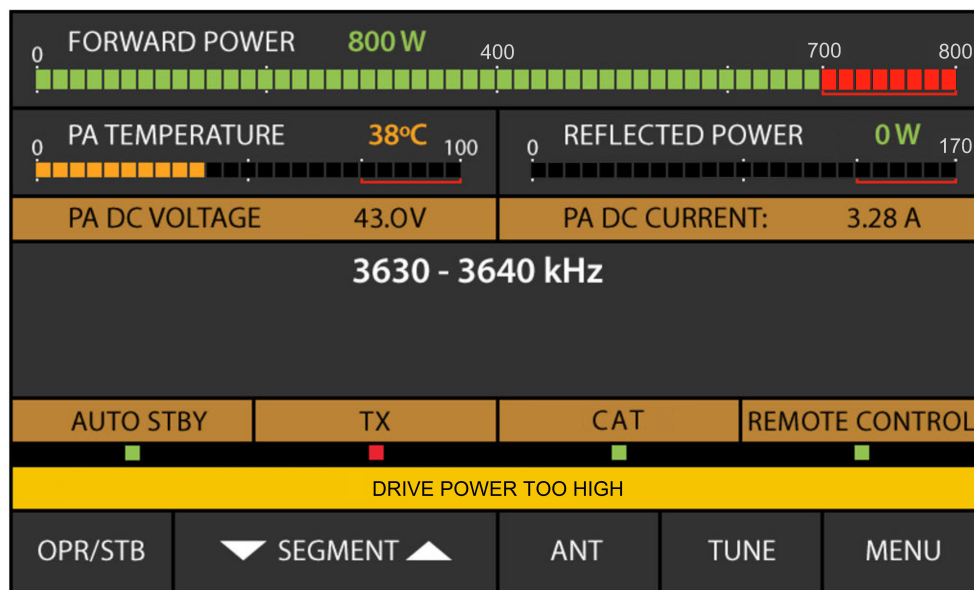


Fig. 4-1 – Appearance of an alarm message

- a) The first protection level is WARNING. When a value watched by the control unit approaches the protection threshold, the transmission is not interrupted, but a message appears – for example “Drive Power too High”, “Drain Current too High”, or another – Fig. 4-1.

You can continue to transmit in these conditions, but you have to take some measures, for example, to reduce a bit the drive power from the transceiver. The warnings remain on the screen for at least three seconds so that they can be read through and will disappear after the reason has dropped off.

- b) The second protection level is a SOFT FAULT – when a value exceeded the safe level, but does not put the amplifier in a danger of a failure.

At the second level (SOFT FAULT) the amplifier reverts to Stand-by mode for four seconds or permanently

depending on whether the “AUTO OPERATE” option had been activated. A respective message is shown on the screen, for example “Excessive Reflected Power”, “Excessive Drain Current”, and others, as well as with a sound alarm (unless the sound had not been muted – S. 5-4).

Unlike those for a WARNING, the SOFT FAULT messages remain on the screen and persist until the operator pushes any button - in order to confirm that the message is read - or until the OPERATE mode will be resumed automatically when the AUTO OPERATE is active – S. 5-4).

SOFT FAULT's call for fast and simple correcting actions by the operator, such as, for example, reducing the drive power, improving of load SWR through retuning the antenna tuner, antenna change, etc.

- c) The third and most serious protection level is a HARD FAULT. The amplifier will be turned off automatically to avoid possible further damages.

When the protection trips off, the data about the fault is stored in the memory and the front panel screen is blanked. There is also a sound alarm - a series of CW letter F.

If the reason for tripping the protection is not obvious, you can try to turn on the amplifier. If the amplifier allows it after the fault, a fault message will appear with information about the reason for the latest automatic shutdown (for example, overheating of the power supply unit or of the PA stage).

After pushing any button, the fault message will disappear, and if there are no current problems (for example, the overheated unit has already cooled down), the amplifier operation will be restored. In the event a parameter maximum is exceeded again, a new message will appear on the screen, or the protection will trip again immediately after the recovery attempt.

If the problem persists, contact your dealer – S. 1-2.

At each “HARD FAULT” shutdown the amplifier stores data, concerning the controls and values, the trip time, and others. Your dealer or his service may ask you to read this data out from the amplifier screen or by RS232 interface and store it in a computer file – see menu FAULTS LOG, Sections 5-5 and 7-4.

5. MENUS – SETTINGS AND OPTIONS

By pushing the MENU button (the rightmost) the user invokes the menu selection screen (Fig. 5). Each menu can be selected by the ITEM (up and down) buttons and SELECT.

The items in each menu are selected and controlled by the same six buttons as in the basic screen, but they have new functions.

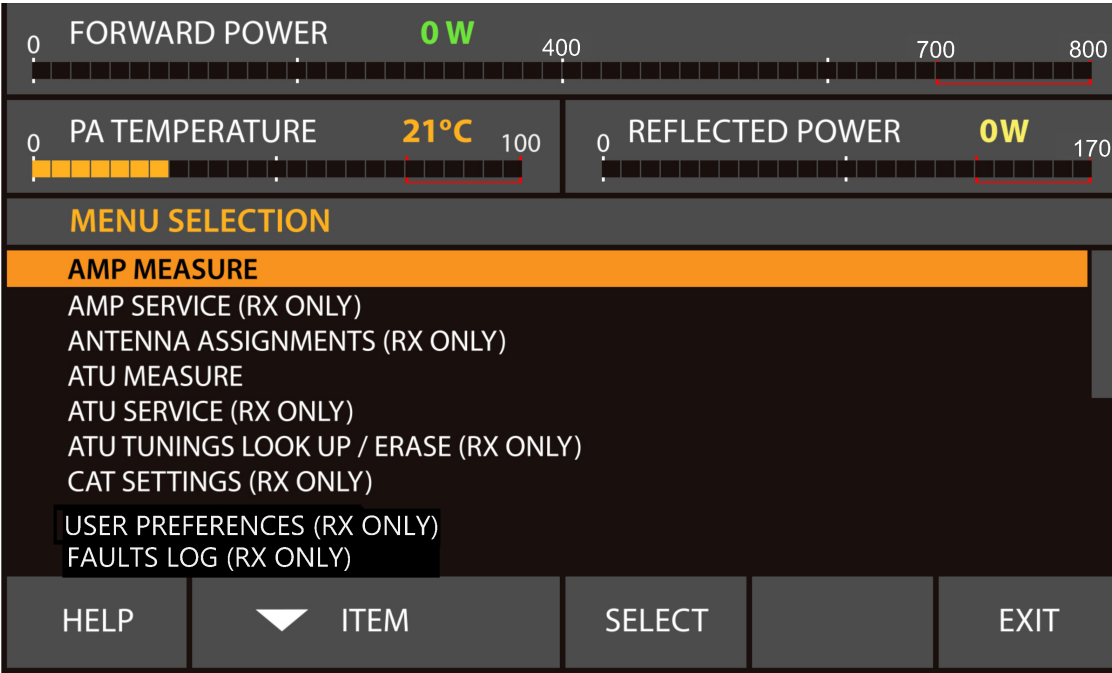


Fig. 5 - MENU SELECTION

5-1. Menu „Amplifier measurements” – AMP MEASURE

The menu AMP MEASURE (Fig. 5-1) is accessible from the MENU SELECTION screen (Fig. 5) in all modes. 11 parameter values be observed continuously.

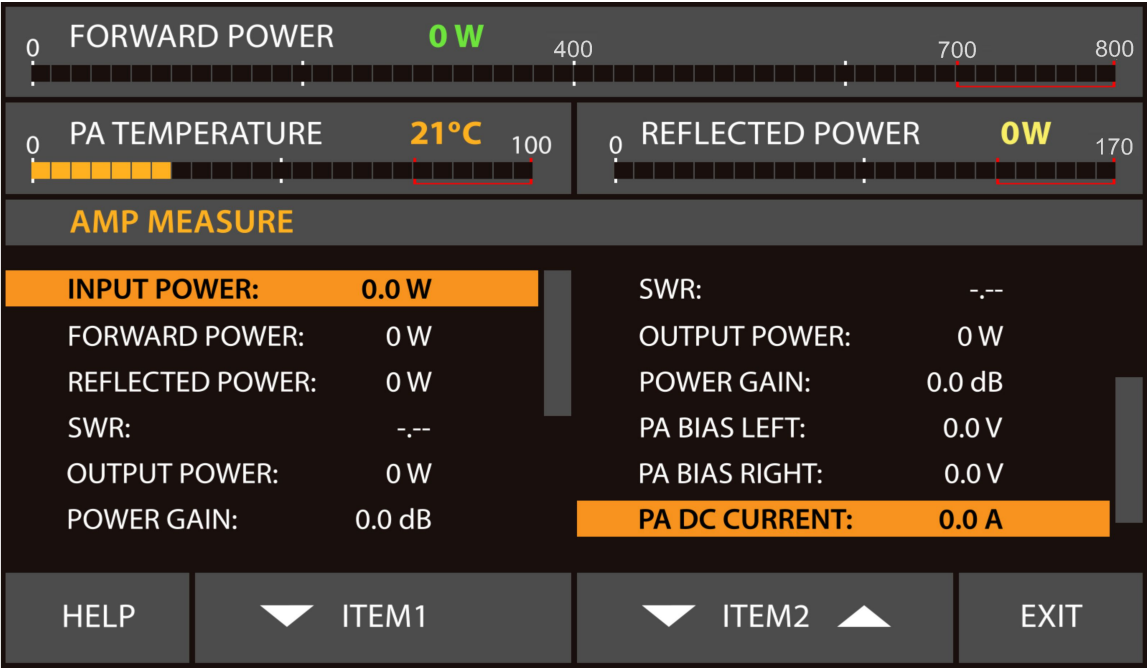


Fig. 5-1 Menu “Amplifier measurements” – AMP MEASURE

Two identical lists appear on the left and the right halves of the screen, each one containing the same 11 values.

Any value can be selected in each screen half. Using buttons ITEM1 and ITEM2 (up and down) select the desired values. The two selected values will be shown continuously on the basic screen (S.3-2 (b), Fig. 3-2) - after leaving this menu (EXIT button).

5-2. Menu “Amplifier service functions” – AMP SERVICE.

The amplifier service menu (Fig. 5-2) is accessible from the MENU SELECTION screen (Fig. 5) at RX mode only.

CAUTION

The AMP SERVICE menu is used for checking and adjustment of the zero-signal (idle) drain current of the final transistors and for testing some functions and circuits of the amplifier when serviced. We recommend these procedures are carried out only by a trained service technician!

The necessary service function is selected with the ITEM buttons (up and down). With the SELECT buttons (left or right) the selected function is turned ON or OFF.

The inactive functions are greyed out and the active are red. When leaving a function submenu, it is turned off and deactivated automatically. At pressing the EXIT button all service functions are turned off, and the MENU SELECTION screen comes back (Fig. 5). At consecutive pushing of the EXIT button, the basic screen returns (Fig. 3-2).

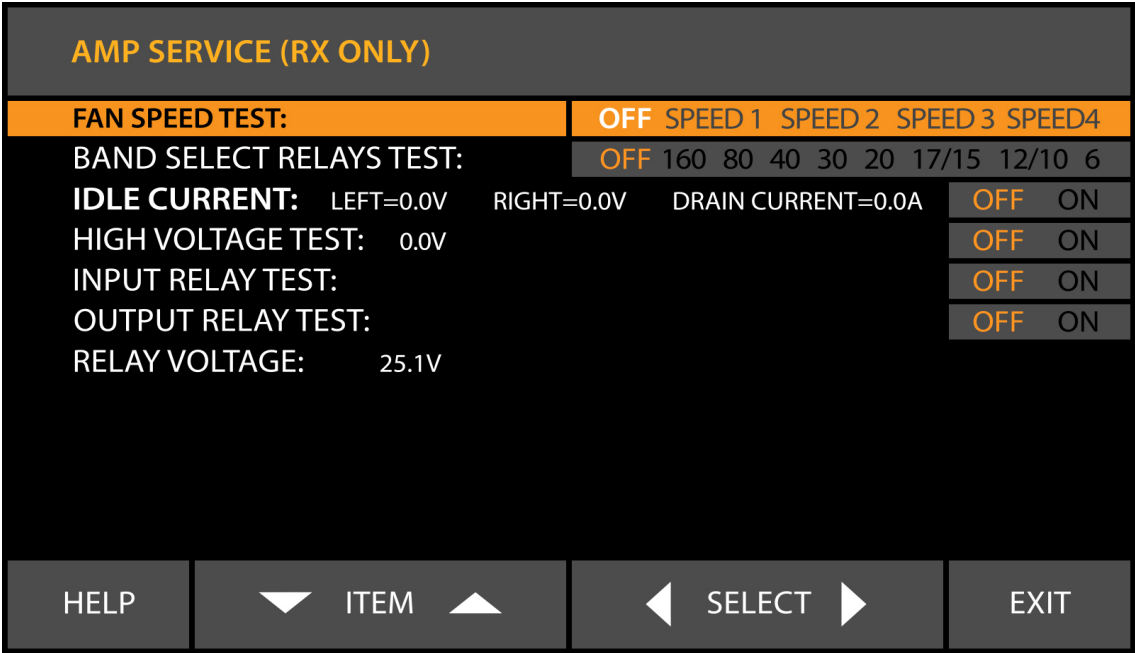


Fig. 5.2 Menu “Service functions in the amplifier” – AMP SERVICE

5-3. CAT SETTINGS MENU

After a CAT cable is connected to both the transceiver and amplifier, the correct settings for the transceiver have to be entered via this menu. If there is no CAT connection, OFF has to be selected as Interface type.

The CAT settings are accessible only in RX mode – Fig. 5 and 5-3. The item is selected by the ITEM buttons (up and down). The value is set with the SELECT buttons (left or right).

If the amplifier CAT port is connected either to the transceiver BCD Band Data or Band Voltage output, select the respective interface type and push EXIT. The other items and values will not be taken into account.

If the CAT cable is plugged into the transceiver's serial port, select the interface and command set according to Table 5-1. The baud rate has to be set to the same value as the transceiver's. The byte spacing and polling time may be left unchanged.

Last select the interface type (RS232 or TTL) according to the table 5-1 and used connection and push EXIT.

CAT/AUX SETTINGS (RX ONLY)							
INTERFACE:	[OFF]	RS232	TTL	BCD	VOLTAGE		
COMMAND SET:	1	2	3	4	[5]		
BAUD RATE, bps:	1200	4800	[9600]	19200	38400	57600	
BYTE SPACING, us:	[0]	50	100	200	500	1000	1500
POLLING TIME, ms:	200	300	[500]	800	1200	1800	OFF
HELP	▼ ITEM		◀ SELECT ▶		EXIT		

Fig. 5-3 Menu "Selection of CAT/AUX interface" – CAT/AUX SETTINGS

Table 5-1

TRANSCEIVER	INTERFACE	COMM SET
ELECRAFT	RS232	5
ICOM (Connection to the REMOTE jack)	TTL	1
ICOM (Connection to the RS232 port or CT17)	RS232	1
KENWOOD TS-2000, 480, 590, 990 and similar	RS232	5
YAESU FT-450, 950, 991, 1200, 2000, 3000, 5000, 9000 and similar	RS232	2
YAESU FT-1000MP	RS232	4
YAESU FT-817, 857, 897	TTL	3

5-4. “USER PREFERENCES” menu

USER PREFERENCES

ANTENNA TUNER / SWITCH INSTALLED

NOYES

AUTOMATIC MENU EXIT:

OFFON

AUTO OPERATE:

OFFON

BEEP VOLUME:

123456

DISPLAY BRIGHTNESS:

123456789

CALL SIGN:

Z

9

9

X

Y

Z

OPERATE ACCESS:

UNLOCKEDLOCKED

TEMPERATURE UNITS:

°C°F

HELP

▼

ITEM

◀

SELECT

▶

EXIT

Fig. 5-4 – Menu USER PREFERENCES

a) ANTENNA TUNER/SWITCH INSTALLED.

If ACOM 04AT remote automatic antenna tuner is also installed, select YES. Refer to ACOM 04AT Operating Manual.

b) AUTOMATIC MENU EXIT.

When the option is turned on, the amplifier exits the currently selected menu if no button has been pressed for more than 5 minutes.

If the option is turned off, the amplifier remains in the currently selected menu until the EXIT button is pushed.

c) AUTO OPERATE.

The AUTO OPERATE option is described in Sections 3-3, 4-1(c), and 4-6(b).

d) CALL SIGN

If entered here, a call sign (or another text) will be included in any Fault Log file generated by the amplifier. The call sign (or another text) will not replace ACOM 700S logo on the startup screen.

Use the SELECT button to select the character position. The ITEM button changes the characters. Finish by moving the pointer out of the editable fields by means of the Left SELECT button.

e) OPERATE ACCESS

When locked, the amplifier remains in Standby and cannot be switched to Operate unless unlocked in the same menu. Passwords are not used – this is only a simple protection against possible child actions.

or involuntary switching to Operate mode. While locked, an attempt for entering Operate mode will result in a message:

“OPERATE MODE IS LOCKED”

The other preference items need no explanation.

5-5. FAULTS LOG

This function reads on the screen the information stored in the memory about the last 28 HARD FAULT protection trips (Fig.5-5). By pushing the FILE button, the information may be also downloaded in a plain-text format file through the RS232 port and a computer using a standard terminal emulating program (TTY). The RS232 protocol is: 9600, 8 N 1.

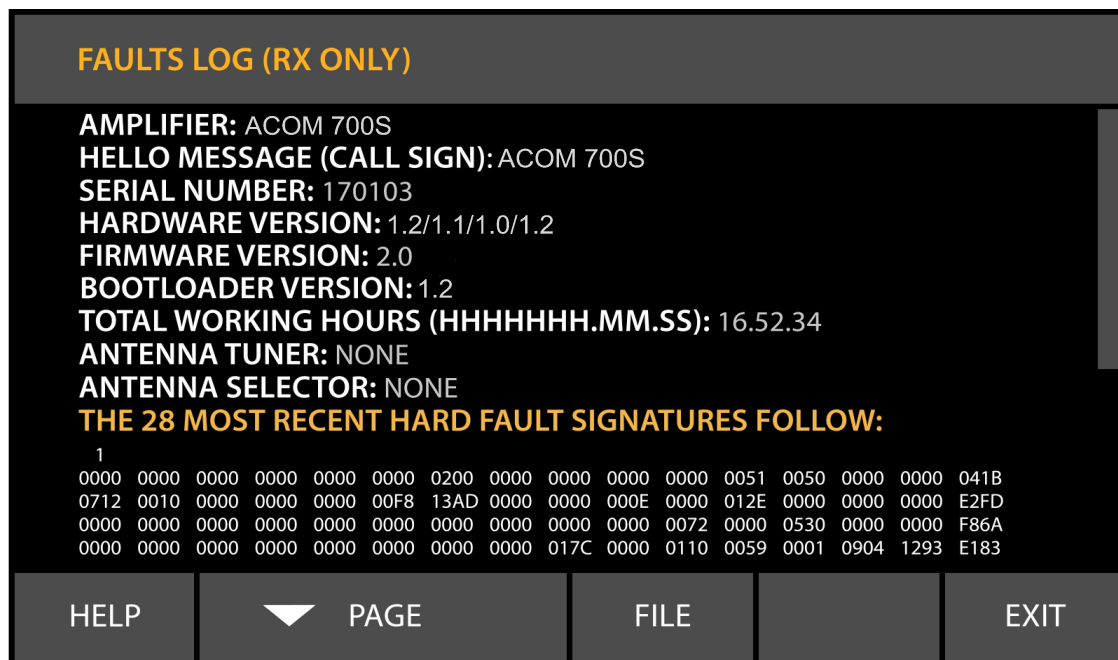


Fig. 5-5 Function FAULTS LOG

5-6. RESTORE DEFAULT SETTINGS

Four different factory reset levels are available (Fig.5-6).

In order to confirm the selected action the operator must push the ACTION - left (YES) button once more. After restoring the default settings, the control will return to the MENU SELECTION screen - Fig. 5. If the ACTION – right (NO) button is pressed, the “NO” is selected again, and the control will not leave the current position. At pressing the EXIT button in this position, the control leaves this menu without changing anything and returns in the previous window (the MENU SELECTION screen – Fig. 5).

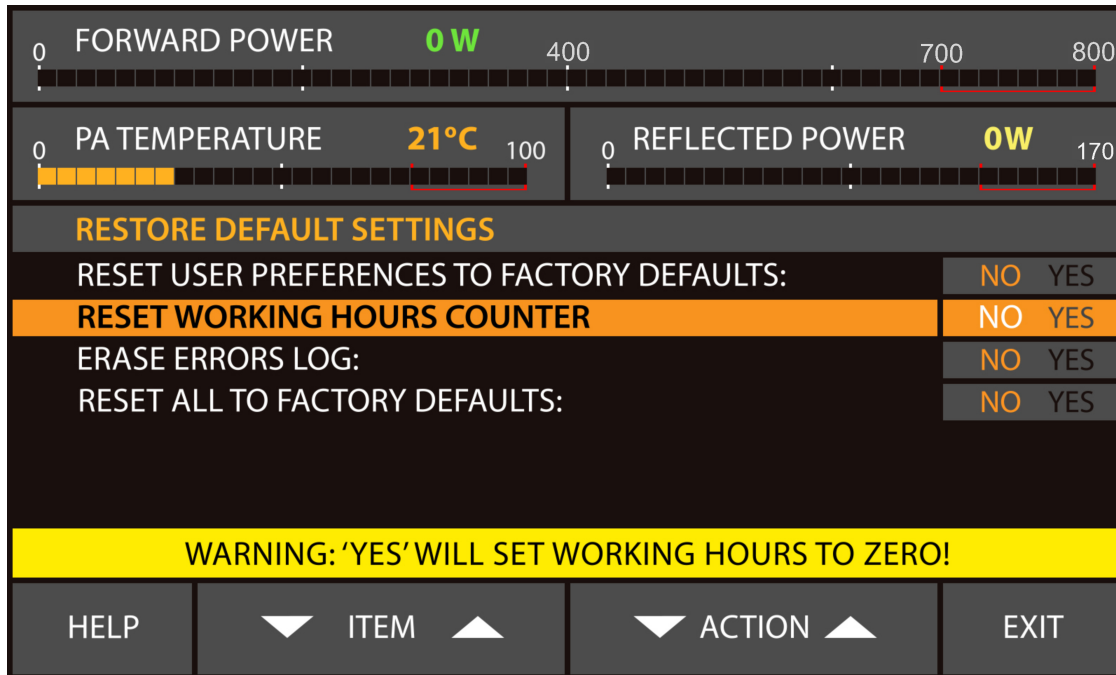


Fig. 5-6 Menu: RESTORE DEFAULT SETTINGS

6. REMOTE CONTROL

6-1. General information

The ACOM 700S may be controlled remotely by the RS232 port.

The ACOM 700S RS232 interface protocol is available on www.acom-bg.com.

7. MAINTENANCE

WARNING HIGH VOLTAGE!

The mains line voltage and a high DC voltage of up to 500V inside the ACOM 700S amplifier are both LETHAL! For your safety, pull the amplifier power plug out of the mains wall outlet and WAIT AT LEAST three minutes EACH TIME BEFORE servicing the amplifier!

7-1. Periodic maintenance; general checks and cleaning

- Periodically (but at least once per year) check all connections, contact cleanliness and the tightening of all connectors, in particular the coaxial ones.

Check the integrity of the cables, in particular when they are layed on the floor. Check also if the cables are secured well in the area where they come out of the connector body.

Pay particular attention to the mains plug and the wall outlet – if you have any doubts consult with an electrician.

Periodically check the SWR of the antennas and if this changes over time. Problems could occur more often in poor weather conditions – rain, snow, strong wind etc.

- b) Periodically (more often in a dusty environment, but at least once per year) clean the air filters without opening the amplifier.

WARNING

The air filters may be too dusty - be careful how you clean them so that you DO NOT INHALE (BREATHE IN) neither spill the dust over! Wrap it, for instance, in a wet cloth before cleaning!

ACOM 700S has one air filter that is accessible from the rear - see Fig. 2.1. The filter is contained in an externally mounted plastic enclosure. The cover of the enclosure, together with the filter itself, is removed by gently pulling it away from the amplifier. Carefully clean the filters and covers from dust, wash them with tap water and *leave them to dry up before you mount them back*. Also clean (as much as possible from the outside, without opening the amplifier) all ventilation apertures on the cover and the chassis, including the ones on the bottom. Finally put the filter back in the filter enclosure cover and click the cover back in place.

CAUTION

Do not use solvents for cleaning – they can be dangerous to you, as well as to the coating or the amplifier plastic parts.

In case of need, clean up the amplifier outside surfaces without opening it. Use a soft piece of cotton cloth, slightly moistened with clean water.

7-2. Replacement of fuses

WARNING HIGH VOLTAGE!

If replacement of fuses is necessary, first pull out the amplifier mains plug from the mains outlet and wait for at least 3 minutes!

The main fuses of the amplifier are located on the rear panel – Fig. 2-1.

The fuses must be of the fast type, European size 5x20mm, rated for 250VAC and rated as follows:

CAUTION

The fuses must be rated for a current corresponding to your mains nominal voltage: 10A for operation from 200-240VAC. Upon customer request: 16A for operation from 100-120VAC mains voltage. Use only standard fuses!

CAUTION

Never replace any fuses inside the amplifier without special instructions from your dealer! Blown internal fuses can be a symptom of a more serious problem, which should be resolved beforehand. Unauthorized replacement of inside fuses infringes the warranty conditions!

7-3. Using the fault codes (signatures) for diagnostics

The data of the last 28 HARD FAULT protection trips is stored in the amplifier memory – see S. 4-6(c).

The data can be downloaded from the memory through the RS232 port and stored in a computer file even if the amplifier cannot be turned on after a serious fault – only external power has to be fed to the Control unit in either of the following ways:

- 8 to 15V DC voltage applied to the “Debug mode” input (Table 2-1) of the CAT/AUX port. The power supply has to be capable to provide 0.4A of current;
- if the Control board has already been removed from the amplifier, it can be powered directly with +5V (0.4A) and the fault log downloaded via the RS232 port.

In the FAULT LOG reading mode (Fig. 5-5), the Control board automatically transmits the data from the memory through the RS232 interface. Depending on the number of fault events stored in the memory, the transmission may take between 0.5 and 12 seconds. A pause of 6 seconds follows, then transmission starts again. The data can be read in a plain-text format with a computer, using a standard terminal program. You can send the recorded file to your dealer or to ACOM accordingly. They could also provide the necessary instructions, if you choose to decode the downloaded hexadecimal data by yourself.

7-4. FIRMWARE UPDATES

CAUTION

Before you change the firmware version, check the new version compatibility with the revisions of the hardware and of the boot loader in your amplifier - see S. 5-5. If you have any doubts about the versions, please consult your dealer *before* you undertake any action.

When ACOM issues a new firmware version, the user can upload it in the amplifier after he checks the compatibility – see the note above.

When compatibility is confirmed a return to an earlier version is also possible.

8. SPECIFICATIONS

8-1. Parameters

a) Standard frequency coverage *:

- 1.800 - 2.000 MHz (160M band)
- 3.500 - 4.000 MHz (80M band)
- 5.250 - 5.450 MHz (60M band)**
- 7.000 - 7.300 MHz (40M band)
- 10.100 - 10.150 MHz (30M band)
- 14.000 - 14.350 MHz (40M band)
- 18.068 - 18.168 MHz (17M band)
- 21.000 - 21.450 MHz (15M band)
- 24.890 - 24.990 MHz (12M band)
- 28.000 - 29.700 MHz (10M band)
- 50.000 - 54.000 MHz (6M band)**

ACOM 700S HF Linear Amplifier - Operation manual

* Extensions or changes of the frequency coverage are possible on request.

** Please refer the applicable region bandplans and laws for specific allocations and limitations.

- b) Rated output power: 700W +/-0.5dB, PEP or continuous carrier.
- c) Intermodulation distortions (IM3): better than 31dB below the rated PEP.
- d) Harmonic and parasitic emissions output suppression: better than 60dB (65dB typically).
- e) Input and output impedances:
nominal value: 50 Ohm unbalanced, UHF (SO239) type connectors;
 - input circuit: broadband, SWR below 1.2:1 (1.1:1 typically); 1.8 – 54 MHz continuous range without retuning or switching;
 - RF by-pass path SWR - below 1.1:1, 1.8-54 MHz;
 - acceptable SWR at the output load (the antenna): up to 3:1 with proportional power reduction
and up to 1.5:1 for full output power;
- f) RF power gain: 14dB +/-1dB (typically 27W for 700W output power);
- g) Mains power supply voltage: 100-240VAC (see 7.2 Replacement of fuses for correct fuse rating and mains voltage range selection).
- h) Mains power consumption at full output power: 1350VA or less with a power factor of 0.95 or higher;
- i) Mains power consumption in Low Energy (waiting) mode: less than 1VA;
- j) Complies with EU safety regulations and electromagnetic compatibility standards, as well as with the US Federal Communications Commission (FCC) rules;
- k) Environmental conditions:
 - temperature range: -10°C to +40°C (14°F to 104°F);
 - relative air humidity: up to 95% @ 35°C (95°F);
- l) Dimensions (projections not included) and weight, operating: (W x H x D) 326 x 143 x 365 mm (12.8 x 5.6 x 14.2 In); 11.8 kg (26.00 Lbs).

8-2. Functions

- a) Receive / transmit control:

KEY-IN input – Phono RCA jack; voltage applied to the transceiver keying output up to +12V; current drawn by the transceiver keying output up to 6mA;

- An optional KEY-OUT output – Phono RCA jack; output resistance: not more than 120 Ohm; maximum safe input voltage from the transceiver +50V; maximum safe current drawn by the transceiver: 20mA;

- **minimum** dead time, necessary for safe amplifier switchover from receive to transmit: 10ms between the transmit request on the KEY IN input and the RF drive on the RF INPUT jack.
- b) Frequency control directly by CAT from the transceiver.
- c) Remote control through RS232 interface.
- d) Remote power on by DSR/DTR and CTS/RTS lines on the RS232 port.
- e) Remote power on/turn off by DC voltage impulse or continuous DC voltage on CAT/AUX port ON_RMT input.

8-3. Storage and shipment

- a) Environment conditions for storage and shipment:
 - temperature range: -40°C to +70°C (-40°F to 158°F);
relative air humidity: up to 75% @ 35°C (95°F);
 - above sea-level: up to 12000m, including the luggage compartment of an aircraft.
- b) Dimensions and weight at transportation (max): (W x H x D) 490 x 330 x 490 mm (19.3 x 13 x 19.3 In); 15.1kg (33.3 Lbs).

9. DISCLAIMER of LIABILITY

All ACOM 700S specifications and descriptions are based on the latest information available at the time of this document's printing. As we are always striving to improve and update our products, ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE and ACOM reserves the right to make changes and improvements at any time without further notice or obligation to notify any person or organization of such revisions or changes, made in order to improve the reliability, function, quality and design and/or performance of the ACOM 700S. Further, this Operating Manual is provided "as is" and ACOM shall not be liable for possible errors contained herein.

NOTES

[illegible]

NOTES

This image shows a full page of primary-ruled paper. It features horizontal dashed lines for writing and vertical dotted lines for margins. The layout is clean and organized, typical of a notebook or worksheet template.