The FL-7000 is a microprocessor-controlled, all solid state linear amplifier with built-in power supply and automatic antenna tuner, providing up to 1.2 kilowatts RF input power on the 160- through 10-meter HF amateur radio bands, including the WARC bands.* Super-fast transmit/receive turnaround timing allows the FL-7000 to be used for QSK CW, HF packet radio and even AMTOR with an exciter so designed. Requiring only 70 watts of excitation for full output, four transistors with 300-watt collector dissipation each are combined in a fully protected push-pull parallel wideband "no-tune" amplifier circuit, powered by a heavy duty regulated 47-V, 25-A DC power supply and cooled by a bottom-mounted fan through Yaeus' own "DVC" (Direct Vertical Cooling) heatsinking system (patent pending). A high-power, low-loss automatic internal antenna tuner automatically rematches the antenna whenever SWR exceeds 2:1.

Band changes are also completely automatic when the FL-7000 is used with Yaeus transceivers equipped with digital band data output, such as the FT-747GX, FT-757GXII, FT-767GX, FT-990 and FT-1000. When changing bands, previously stored antenna selection and tuner setting are recalled from lithium-backed memories automatically; transmission and retuning are not required. When rematching to a new load, the power amplifier section automatically turns off until the antenna has been matched.

Six different parameters in the amplifier, power supply and tuner are simultaneously monitored by the protective circuitry to avoid distortion of the rf output as well as to protect the components: collector current, driving power from exciter, temperature of amplifier and regulator heatsinks, VSWR at output, push-pull circuit balance and ALC voltage fed back to exciter. Dual 2-speed cooling fans are controlled with independent thermal sensors, for the amplifier and power supply. Two large, clearly lit meters provide constant monitoring of amplifier current concurrently with either relative power output, supply voltage, automatic VSWR or ALC. Eight LEDs on the front panel inform the operator of tuner and protection system status, including fan activity and high/low speed. Additional LEDs indicate the selected band and antenna. Up to four different antennas can be connected and automatically selected by the FL-7000's microprocessor for different bands when the optional FAS-1-4R remote antenna relay unit is used.

Without costly vacuum tubes there is no need for a dangerous high-voltage supply in the FL-7000, eliminating the problems of tube and high voltage component failures. However, should your FL-7000 ever need realignment, it has been designed with every alignment point easily accessible by simply removing the top cover.

To assure optimum performance and safety, please read this manual carefully before connecting the FL-7000 to the power source and your transceiver.

* excluding 10- and 12-meter bands in USA version (may be added upon proof of license).
Specifications

**General**

Frequency coverage (MHz): 1.8 ~ 2, 3.5 ~ 4, 7 ~ 7.5, 10 ~ 10.5, 14 ~ 14.5, 18 ~ 18.5, 21 ~ 21.5, and 24.5 ~ 25, 28 ~ 30 except in USA version

Collector input power (final transistors):
- 1200 W PEP (SSB), 1200 W DC (CW),
- 600 W DC (FSK), 550 W DC carrier (AM)

Continuous Full Power Transmission Period:
- (SSB) 100% for 30 min.,
- (Full Carrier) 100% for 1 min.

Case size (WHD): 390 x 130 x 400 mm

Weight: 30 kg (66 lb)

Supply voltage: 100/110/117/200/220/234 VAC ± 10%

Power consumption: 1900 VA max
  (@500 W RF output)

**Linear Amplifier Section**

Excitation power: less than 100 W for 1200 W input

ALC voltage (output) range: 0 to -9 V

Spurious radiation: less than -50 dB

Third-order IMD: less than -25 dB

Input/Output impedance: 50 ohms, unbalanced

**Automatic Antenna Tuner Section**

Impedance matching ranges:
- (1.8 ~ 2 MHz) - 25 to 100 ohms, unbal.
- (other amateur bands) 16 to 150 ohms, unbalanced

Maximum feedthrough power: 600 watts

Insertion loss: less than 0.5 dB when tuned to match

VSWR after matching: 1:1 to 1:2:1

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**Accessories**

**Supplied**

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty</th>
<th>Yaesu p/n</th>
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<tbody>
<tr>
<td>Coaxial Cable (for Transceiver-to-Linear)</td>
<td>1</td>
<td>T9100380</td>
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<tr>
<td>ALC &amp; PTT Connection Cables with Phono Plugs</td>
<td>2</td>
<td>T9101296</td>
</tr>
<tr>
<td>Band Control Cable for FT-757GX(II)</td>
<td>1</td>
<td>T9102337</td>
</tr>
<tr>
<td>20A Fuse (for 100-120 VAC operation)</td>
<td>1</td>
<td>Q0000009</td>
</tr>
<tr>
<td>10A Fuse (for 200-234 VAC operation)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Long Feet (to allow increased ventilation)</td>
<td>2</td>
<td>R3054620</td>
</tr>
<tr>
<td>Foot Pad (for long or short foot)</td>
<td>6</td>
<td>R7054630A</td>
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**Optional**

<table>
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<th>Qty</th>
<th>Yaesu p/n</th>
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<tbody>
<tr>
<td>FAS-1-4R Remoto Antenna Selector</td>
<td></td>
<td>D3000198</td>
</tr>
<tr>
<td>Band Control Cable for FT-747GX, 767GX, FT-990 or FT-1000</td>
<td></td>
<td>D4000019</td>
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<tr>
<td>Band Control Cable for FT-980</td>
<td></td>
<td>D4000014</td>
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</tbody>
</table>
Indicators, Switches & Jacks

Front Panel

(1) IC Meter

This meter indicates total amplifier collector current, in Amperes.

(2) Multimeter and Selector Switches

This meter indicates PO (Power Output), Vcc (DC collector voltage at final transistors), VSWR (Voltage Standing Wave Ratio) at the antenna jack, or ALC (Automatic Level Control) voltage fed back from the Amplifier to the exciter. The function to be displayed is selected by the corresponding push-button switches to the right of the meter.

(3) Function Status Indicators

These eight LEDs indicate the operational status of the amplifier, power supply and antenna tuner circuits, as follows:

(4) BAND Indicators

One of these nine green LEDs will be lit to indicate the selected operating band of the amplifier.

(5) ANTENNA Indicators

One of these four green LEDs will be lit to indicate the antenna selected via the optional FAS-1-4R Remote Antenna Selector, if used. Otherwise, these indicators and the corresponding switches may be ignored.

(6) POWER ON/OFF Switch

This is the main power switch. When off ( ), the exciter is connected directly to the antenna (No. 1 if the FAS-1-4R is in use). If this switch is turned off while the power supply and amplifier are hot, the PS TEMP, FAN1, FAN2 indicators and fans will remain on until the respective units have cooled sufficiently.

LED Color Circuit Lit Condition
READY green ATU Antenna is tuned
WAIT yellow ATU Tuner is working
WARNING red ATU SWR is too high
PROTECT red all (see below)
SEND red Amp Transmission
PS TEMP yellow PSU PSU temp is high
FAN1 green PSU PSU fan is on low
FAN2 green Amp Amp fan is on low

When one of the automatically monitored parameters exceeds safe limits the PROTECT indicator flashes while the microprocessor takes defensive action, as described in the "Operation" section.
(7) **SSB/RTTY Push Switch**

This switch selects final transistor collector voltage and ALC circuits for either semi- or non-continuous-duty modes, to optimize performance for the different requirements. Set this switch to the depressed position (△) for semi-continuous-duty modes (RTTY, FM, AMTOR, packet & SSTV). Otherwise it should be in the undepressed position for non-continuous-duty modes (SSB, AM & CW).

(8) **OPERATE Push Switch and LED**

When this 2-position switch is in the depressed position (△), the amplifier will be functional and the green indicator will glow when the exciter is activated. When in the undepressed position, the amplifier is bypassed and the indicator will not light when the exciter is activated. See the diagram below. The function of this switch is overridden by the microprocessor if the **PROTECT** indicator is blinking.

(9) **TUNER Push Switch and LED**

When this 2-position switch is in the depressed position (△) the corresponding green indicator is lit and the antenna tuner is in the circuit between the amplifier and the antenna. When in the undepressed position, the antenna tuner is bypassed, and the amplifier connects directly to the antenna. See the diagram above.

(10) **MANUAL Push Switch and LED**

When this 2-position switch is in the depressed position (△) the corresponding green indicator is lit and the operating band of the FL-7000 can be selected manually via the **BAND DOWN/UP** buttons. When in the undepressed position the band is selected automatically by the transceiver (FT-980, FT-747GX, FT-757GX, FT-767GX, FT-990 and FT-1000) via the optional band control cable, if used.

(11) **BAND UP/DOWN Push Buttons**

These buttons are required for band changing when using an exciter not equipped with the Yaesu band control jack and optional band control cable. When the **MANUAL** push switch is depressed, these buttons step the operating band of the FL-7000 up or down. The selected band is indicated by one of the nine green LEDs at the upper right of the front panel.

(12) **ANTENNA 1 ~ 4 Selector Buttons**

These four push buttons can be used to manually select one of up to four antennas when the optional FAS-1-4R Remote Antenna Selector is connected. The antenna selection is stored in memory, so once selected and matched on a particular band, the same antenna will be reselected automatically when recalling that band. If the FAS-1-4R is not used, these buttons have no function.

(13) **START Push Button**

This momentary-contact button activates the auto-tune system manually. Normally, when the operating band is changed, the tuner will automatically adjust itself for the same antenna selection and matching impedance set the last time that band was used. Press the **START** button to retune if you are on a different part of the band, or if the SWR is still too high after automatic tuning. Manual restart with this button can be used to force retuning the antenna at any time.

(14) **TUNE and LOAD Buttons**

These two pairs of buttons allow manual adjustment of the matching network of the antenna tuner. The buttons under the left-pointing arrows increase capacitance, and those under the right-pointing arrows decrease capacitance. In some cases it may be desirable to “tweak” the automatic tuner settings manually by poking these buttons while watching VSWR indication on the multimeter. These buttons are disabled when the automatic tuning system is active, and when the **TUNER** switch is off.
Indicators, Switches & Jacks

Rear Panel Connectors

(1) **GROUND** Terminal Post
Connect this terminal to a good earth ground using the shortest practical length of heavy bared cable. All other station equipment should be grounded to this terminal.

(2) **ANTENNA** Jack
Connect this type M (SO-239) jack to the antenna or input jack of the FAS-1-4R using large (RG-8/U or larger) 50-ohm impedance coaxial cable with the mating plug (type M, PL-259).

(3) **ACC-1** Accessory Jack
This 28-pin jack is provided for the optional control cable for the FT-980, to allow automatic band selection and t/r control from the FT-980, and transmitter sequencing of the FT-980 from the FL-7000.

(4) **ACC-2** Accessory Jack
This 8-pin molex jack provides for automatic control with the FT-747GX, FT-757GX(1), FT-767GX, FT-990 and FT-1000 transceivers, as described for the **ACC-1** jack and FT-980, above. Optional band control cables are listed on page 2.

(5) **REMOTE** Terminal Strip
These terminals provide switched 13.5 VDC control signals for the optional FAS-1-4R Remote Antenna Selector. The terminal labels correspond to those on the FAS-1-4R.

(6) **INPUT** Jack
This type M (SO-239) jack should be connected through the supplied short 50-ohm coaxial jumper to the (transmitting) antenna jack of the transceiver.

(7) **SSB ALC & RTTY ALC** Controls and **ALC** Jack
These control allows adjustment of the ALC voltage level (output) for non- and semi-continuous-duty modes, provided at the **ALC** phono jack, for control of the exciter. The front panel **SSB/RTTY** switch selects which control sets the level at the jack. Maximum ALC range is 0 to 9 VDC at this jack.

(8) **PTT** Jack
Shorting the contacts of this jack activates the amplifier for transmission. This function must normally be provided by amplifier control contacts in the t/r relay in the exciter: closed to transmit. Open circuit voltage at this **PTT** jack is +12 VDC, and maximum closed circuit current required is 10 mA.

(9) **ATT/OFF** Slide Switch
This switch attenuates excessive input from the exciter. It should be set to the **ATT** position if exciter output exceeds 100 watts PEP, such as the FT-1000, and to the **OFF** position for other transceivers.

(10) **FUSE** Holder
This holder must contain a 20-A fuse if the amplifier is operated from 100 — 117 VAC, or a 15-A fuse if operated from 200 — 234 VAC. Make certain that the fuse is correct for the AC voltage used.
Installation

Unpacking and Inspection

Carefully remove the amplifier from its packing carton and examine it for any signs of visible damage. Check the buttons and switches to ensure nothing has broken loose. If any damage is found, document it thoroughly and notify the shipping company at once. Save the packaging materials for possible use later.

Installation Procedure

The amplifier must be located so that air can circulate freely around the top, bottom and rear of the cabinet. Do not place anything on top of or under the amplifier that might obstruct airflow.

Important!

If you expect to use much RTTY, AMTOR, FM, SSTV or packet, replace the short front feet with the longer feet provided, to allow for more airflow through the chassis.

Refer to the interconnection diagrams later in this chapter for details of installations with specific transceiver models. Regardless of the model used, make certain that the ALC jack on the amplifier is connected to the external ALC input of the transceiver, and that the transceiver is designed to respond to external ALC within the range of 0 to -9V. The PTT jack on the amplifier must also be connected to T/R relay contacts in the transceiver that are closed during transmission. This line is included in the band control cable connections, if you are using an FT-747GX, FT-757GX(II), FT-767GX, FT-980, FT-990 or FT-1000 with optional band control cable.

Use the supplied short length of 50-ohm coaxial cable (or equivalent) with type M (PL-259) connectors on both ends to connect the transceiver antenna jack to the INPUT jack on the amplifier. For the feedline from the ANT connection on the amplifier to the antenna or FAS-1-4R Remote Antenna Relay Unit, do not use small coaxial cable such as RG-58A/U, as it is not intended to handle the output power level of the FL-7000. Use the largest and best quality 50-ohm coaxial feedline available for this connection.

If the exciter (transceiver) being used with the FL-7000 produces more than 100 watts RF output, such as the FT-1000, set the ATT/OFF switch to the ATT position. The FL-7000 requires only 70 watts drive to produce full output, and additional drive power will merely be wasted generating heat.

Power Connections

The power supply in the FL-7000 is capable of operation from 100/110/117/200/220 or 234 VAC at 50 or 60 Hz. However, the primary of the power transformer must be wired to match the AC mains voltage you intend to use, as must the amplifier fuse. If you have a choice between two voltage ranges, use the higher voltage to minimize losses in the AC cable and transformer. Make certain that the voltage specification marked on the rear panel of the amplifier matches the AC supply voltage you intend to use. If it does not, remove the top cover of the amplifier and reposition the transformer tap connections as indicated in the diagram below (and on the left side of the chassis).

If you change the power transformer connections from one range to the other, the fuse in the rear panel holder must be replaced. For 100/110/117 VAC use

WARNING!

Severe damage may result if improper AC supply voltage is applied to this equipment. Our warranty does not cover damage caused by improper supply voltage or an improper fuse.
only a 20-amp fuse. For 200/220/234 VAC use only a 15-amp fuse.

It is best to use a 200/220 or 234 VAC line exclusively for the amplifier, with its own 10-Amp circuit breaker or fuse at the house fuse box. If only 100-/110/117 VAC is available the line should have wiring of sufficient size for 20 amperes, and be fused for 20 amps at the fuse box, and that line used only for the amplifier. The FL-7000 should not be operated from a standard 100/110/117-V house lighting circuit, as the wiring may not be large enough to carry the load.

**Antenna Requirements**

Any antenna used with the FL-7000 must be capable of dissipating at least 600 watts, and should be at or near resonance at the operating frequency, having a feedpoint impedance as close as possible to 50 ohms. In the FL-7000, the amplifier stage alone performs optimally with a load SWR of 1:1 at 50 ohms. With an SWR of 2:1, power output will be reduced by about 3 dB (one-half). The automatic antenna tuner in the FL-7000 expands the acceptable SWR range considerably, being able to reduce a 3:1 SWR to 1:1 above 3.5 MHz (or from 2:1 to 1:1 on 160 meters).

While the resulting operational SWR range of the FL-7000 is wide enough to add considerable operating flexibility, it is not unlimited. If the tuner stage is unable to bring the SWR below 1.2:1 (as presented to the amplifier stage), the protective circuitry will cause the amplifier stage to be bypassed, and the **WARNING** indicator will be lit, indicating that remedial antenna work is necessary. Although operation in this case will not damage the (bypassed) amplifier, it is not recommended. Antenna systems that are too far from resonance at the operating frequency to permit proper matching should be reworked, or used only on frequencies where a 1.2:1 SWR can be obtained, and other antennas should be installed for other frequencies.

The FAS-1-4R Remote Antenna Switching Unit is designed to allow remote selection of up to four antennas, with a single feedline and control cable from the FL-7000 to the FAS-1-4R, which may be mounted remotely at the antenna feedpoint(s). After being manually set once, the correct antenna for each band is selected automatically whenever the operating band is changed in the FL-7000.

The FL-7000 and FAS-1-4R Remote Antenna Selector are designed for unbalanced (coaxial) feedlines. Use balun transformers for feeding antennas requiring balanced feed. Such baluns should provide 50 ohms at the unbalanced side, and then 50-ohm coaxial cable should be used to make connections to the equipment. If a portion of the feedline is open-wire type, the length of coax used between the feedline balun and the amplifier should be as short as possible to minimize loss.

**Interconnections**

The diagrams below and on the following pages illustrate the interconnections between various HF transceivers and the FL-7000 and optional FAS-1-4R. Be certain to install the earth ground connection directly to the amplifier, with a short, independent grounding cable from the FL-7000 to the transceiver, in addition to the other connections shown.

Note that the FT-757GX, FT-767GX and FT-980 transceivers have a linear amp switch on the rear panel (labelled **LINEAR** or **LIN AMP**) that must be specifically set when the FL-7000 is connected, to allow the amplifier to inhibit transmission during band changing. The diagrams for these models also show a special interconnecting cable, available as an option from your Yaesu dealer. This cable allows band switching in the transceiver to control the band selection in the FL-7000 automatically. Other transceivers, or these models without the optional cables, may be used with band selection of the FL-7000 using the front panel **MANUAL** buttons.
Operation

Preliminary Checks

Before switching on power, recheck all interconnections as described in the preceding section. Double check the ground and antenna connections, and the ALC connection cable. If using an FT-980, ensure that the LIN AMP switch on the rear panel is set to (upper) position 1. If using an FT-757GX(1) or FT-767GX ensure that the LIN or LINEAR switch is depressed (position 1). The FT-990 and FT-1000 do not require special switch setting on the transceiver, but the ATT switch on the back of the FL-7000 must be set to the ATT position for the FT-1000.

If using one of the above transceivers with a band control cable, band selection and antenna rematching will occur automatically whenever you change bands on the transceiver. In this case, if you are also using the FAS-1-4R with multiple antennas, the antenna last used on each band will also be reselected when that band is recalled on the transceiver. In this case, do not press the MANUAL switch unless you specifically want to disable the automatic band and antenna selection functions.

If you are using a transceiver without a band control cable, press the MANUAL switch on the FL-7000. This switch should remain pressed at all times when the automatic band selection feature is not connected. Whenever changing bands, you will need to remember to press the BAND UP and DOWN keys to match the operating band of the FL-7000 with that of the transceiver.

Caution!

Do not move the ATT switch or attempt to change bands while transmitting.

Initial Preparations

These few paragraphs are just to prepare you for the procedures described in detail in the later sections. You should read these before turning on the FL-7000, to get a sense of what you will need to do.

Initial setting of the antenna tuner (when the FL-7000 or antenna is new) will require that you transmit a steady carrier at full (exciter) power over the air for a few seconds (the FL-7000 power amplifier section is automatically bypassed during this process). We recommend that this be done in the CW mode. If you do not have a key or keyer paddles connected, you can just press the MOX switch on the transceiver to key the transmitter. If you normally have your key or keyer paddles plugged into the transceiver you can close the key contacts to transmit (make sure the internal keyer in your transceiver is switched off, if you have one). If you are using an external electronic keyer you will need to short the output for tuning; do not try to tune up with a string of dits or dahs.

Always listen for a short while to make certain that the frequency is clear before keying the transmitter (you may be required by law to transmit your callsign at the beginning and end of transmissions). After initial tuning the FL-7000 will automatically store the tuner settings in memory and recall the stored settings when changing bands, without the need to transmit a carrier again.

First-Time Power-Up & Check-Out

☐ Set all front panel switches on the FL-7000 to their undepressed (■) positions, except the VCC meter select switch (and the MANUAL switch, if you are not using a band control cable).

☐ Press the FL-7000 POWER switch to turn it on, and confirm the VCC indication on the meter is about 47V. The WAIT indicator should light while the antenna tuner tunes to the preset position (set at the factory with a 50-ohm dummy load). After a few seconds, the WAIT indicator should turn off and the READY indicator light.

☐ Press the SSB/RTTY switch and confirm the VCC indication drops to about 32V. Return the SSB/RTTY switch to the undepressed position.

☐ If you have the FL-7000 connected to the transceiver with a band control cable, just confirm that the FL-7000 band indicators change appropriately when changing bands on the transceiver (without transmitting). The WAIT indicator will be lit while changing bands, and will turn off a few seconds after you have selected the desired band (and READY will light).

If the FL-7000 band indicators do not change when changing bands on the transceiver, the band control cable is not connected (or at least not properly). You can still change bands manually by keeping the MANUAL button in its depressed position and using the BAND UP and DOWN keys. Confirm that this works properly.
Drive Power Check

If this is first-time operation, or whenever using a different exciter (transceiver), perform this procedure to check peak exciter driving power.

- Make sure the OPERATE and TUNER switches on the FL-7000 are both off.

- Connect a 100 watt dummy load to the FL-7000, if available. If a dummy load is not available, tune the transceiver to a clear frequency (for which your antenna is designed).

- Set the transceiver to CW mode, and preset the DRIVE control on the transceiver fully clockwise (maximum).

- If you have the MANUAL switch depressed, press the BAND UP and DOWN keys while observing the band indicators at the upper left of the front panel, to select the same band selected on the transceiver. Otherwise, if a band control cable is used, band selection should be automatic, but you should confirm this by noting whether the band indicators on the transceiver and the FL-7000 match.

- If you have the optional FAS-1-4R Antenna Selector connected, press the appropriate ANTENNA button (1-4) to select a dummy load or the proper antenna. If not using the FAS-1-4R, ignore this step.

- Press the FL-7000 PO meter select switch, and while watching the PO scale of the FL-7000 multimeter, briefly key the transmitter.

- If the (indicated) exciter power was above 100 watts, turn the ATT switch on the rear panel on. Never move the ATT switch while transmitting.

Drive power must be at least 50 watts for accurate SWR detection, and 70 to 80 watts for optimum tuner performance. When the FL-7000 power amplifier section is activated, ALC voltage is fed back from the amplifier to the transmitter, to reduce power output to this level. However, much higher drive power to the amplifier will cause the protective circuitry to disable the amplifier (to avoid damage to the input circuits).

WARNING and PROTECT Indications

If the antenna impedance is too far from 50 ohms, or if there is too much reactance in the antenna system (or if the drive power is too low when matching the antenna), the ATU may be unable to find the minimum SWR point, and the WARNING or blinking PROTECT indicator will come on after a few minutes, instead of the READY indicator. If this happens, press the PO button and check the PO scale of the multimeter to ensure that the transmitter is providing at least 70 watts output, and then return to receive.

The WARNING lamp indicates that the SWR is too high. This can usually be confirmed during antenna matching, where the SWR meter indication will be above 3:1.

To remedy this situation the antenna or feedline will generally have to be repaired or replaced with one having an impedance closer to 50 ohms on the selected band. However, if the SWR indication is close to 3:1, it may be possible to obtain a better match by restarting the tuner: first recheck the antenna connections, and that the transmitter is set for at least 70 watts output. Then repeat the antenna matching procedure. If the WARNING lamp is still on after tuning, rework or replace the antenna.

The blinking PROTECT lamp indicates one or more of the following potentially dangerous conditions:

- One or both of the power supply or amplifier heat-sinks is overheated.

- Drive level from the exciter (transceiver) has exceeded 80 watts, despite ALC fed back from the FL-7000 to control excitation.

- ALC voltage is more negative than -9V.

- More than 50 watts of imbalance has occurred between the two sections of the power amplifier.

When the microprocessor senses one of these conditions, it bypasses the power amplifier. The only way to reset from the protected state is to turn the FL-7000 POWER switch off. If overheating caused the protector to trip, the PROTECT lamp will flash again, and the FL-7000 cannot be used until it cools.

If overdrive or excessive ALC voltage caused the protector to trip, check the ALC connection to the transceiver, and that the exciter power level is not more than 100 watts (set the ATT switch on if it is).

Imbalance of the power amplifier indicates probable damage to the Combiner or PA sections of the FL-7000. The protection afforded by this feature lessens the chance of damage to the final transistors.
Operation

Initial Antenna Matching Procedure

☐ Press the SWR meter select switch, and then briefly key the transmitter while watching the SWR scale of the multimeter, and note the indication. (SWR calculation is automatic, so no full-scale presetting is necessary).

☐ If the SWR indication was above 1.5:1 (but below 3:1), activate the ATU (Antenna Tuning Unit) to retune, as follows;

(a) Press the TUNER switch.

(b) Key the transmitter.

(c) Press the START button.

☐ After a minute or so, the READY light will come on if the tuner is able to match the antenna. If not, WARNING or PROTECT will come on. In any case, stop transmitting as soon as the WAIT light turns off (but not before).

☐ If WARNING or PROTECT came on, see the box on the previous page.

☐ If the READY light is on after tuning, press the PO meter select switch and the OPERATE switch. The FL-7000 is now ready for operation, described in the next section. However, for first time operation (or when using a new transceiver), perform the next two steps first to set the ALC controls properly.

☐ Make sure the SSB/RTTY switch on the front panel is set to the underdamped (SSB) position, and locate the SSB ALC potentiometer on the rear panel. Key the transmitter (in CW mode), and adjust this control, if necessary, for 500 watts on the PO meter. If on the 160m band, adjust the ALC control for 20 Amperes on the IC meter.

☐ Press the SSB/RTTY switch (to the RTTY position), and locate the RTTY ALC potentiometer on the rear panel. Key the transmitter (again in CW mode), and adjust this control for 250 watts on the PO meter. This ALC control allows the amplifier to operate at higher efficiency when run at reduced power output, as is needed for semi-continuous-duty operation.

Linear Amplifier Operation

Although continuous full exciter power is required for accurate SWR measurement and antenna matching, this will cause overheating if transmitting for an extended period when the OPERATE switch is depressed (that is, when the power amplifier section is on). So once the antenna has been matched the first time, back off the exciter DRIVE.

For SSB and CW operation, make sure to adjust the MIC gain and/or DRIVE controls on the transceiver for proper ALC indication on the transceiver ALC meter, as described in the transceiver manual. Generally, for SSB, ALC meter indication should not deflect beyond a certain ALC limit (the ALC zone on the transceiver’s meter) on voice peaks; while for CW, the ALC indication should be just enough to cause slight meter deflection. Higher ALC levels are likely to produce distortion or key clicks, without additional power. The PO meter selection on the FL-7000 should indicate 500 watts at full power, as set by the SSB ALC control on the rear panel.

After setting the DRIVE or MIC gain as indicated in the transceiver manual, press the ALC meter select switch on the FL-7000, and confirm that the indication is within the ALC zone on the linear’s multimeter.

For FM, SSTV, RTTY, AMTOR or packet, make sure the SSB/RTTY switch on the front panel of the FL-7000 is depressed, and adjust the DRIVE control on the transceiver so that the PO meter on the FL-7000 indicates 250 watts (maximum) while transmitting, as set by the RTTY ALC control on the rear panel. This is a safe level that will not cause overheating during continuous operation for extended periods.

For AM operation, adjust the DRIVE control on the transceiver so that the PO meter on the FL-7000 does not exceed 100 watts when transmitting a carrier (this is roughly equivalent to 300 watts PEP when modulated). On voice peaks, the PO meter should fluctuate not more than about one width of the meter needle.

During transmissions (in any mode), the PS TEMP and FAN indicator LEDs on the FL-7000 will come on as the heatsink temperatures rise. This is normal. However, if you push the amplifier too hard, with long transmissions at full power, the PROTECT function will take over and disable the amplifier, in which case it will shut itself down and require toggling the POWER switch to reset the protection circuitry (after cooling).

Manual Tweaking and Retuning

During normal amplifier operation, the SWR detector circuitry senses the full output power of the amplifier, and indicates the resulting SWR on the multimeter when the SWR button is pressed. After automatic tuning, if you believe you can improve the match of the tuner further, use the TUNE and LOAD arrow keys to change the capacitor settings while watching the SWR meter closely. This can be done at full power with the amplifier section on (OPERATE switch depressed), but must be done very carefully (usually with just a few quick touches to the keys) while transmitting a steady carrier. If you allow the SWR indication to exceed 2:1, the
Operation

The microprocessor will automatically disable the TUNE and LOAD keys, shut off the amplifier section, and attempt to rematch automatically. If this happens, keep the carrier on until the tuner finishes (READY lights).

Similarly, if you tune to a different part of the same band, the ATU will sense the SWR when you transmit, and will automatically attempt to rematch the antenna if the SWR exceeds 2:1. When this happens, keep the transmitter keyed with a steady carrier (in SSB, you can hum or whistle a steady note) until READY lights.

If you change frequency enough to cause a slight rise in SWR (less than 2:1), you can press the START key while transmitting a steady carrier to force automatic retuning, or you can use the TUNE and LOAD keys (gingerly), if you wish, to clip the SWR again.

When rematching the antenna, manually or automatically, remember: always watch the SWR meter, key the transmitter and apply a steady carrier. Bear in mind that the ATU requires 50 to 80 watts steady drive to tune properly, and that the power amplifier section of the FL-7000 is automatically bypassed by the ATU while it is tuning.

Band Changing

When new, the FL-7000 must be set up as in the previous section for each band. If you are not using a band control cable and one of the Yaesu transceivers noted at the beginning of this chapter, you must remember to change the band selected on the FL-7000 whenever the transceiver band is changed. When changing bands, the microprocessor will automatically recall the ATU settings last used on that band. Also, if the optional FAS-1-4R is connected with multiple antennas, the last antenna selected on a band will be recalled when returning to that band. If the FAS-1-4R is not being used, remember to reconnect the antenna last used on a band when it is recalled.

Press the SWR button to check SWR when you change bands, to make certain that the memorized settings of the ATU are correct for the antenna and frequency of operation. If the SWR is high, key the transmitter and press START to rematch.

Operating Precautions

Summarized below are some precautions to adhere to in order to ensure long life and trouble-free operation with the FL-7000:

- Do not transmit after changing bands until the READY indicator comes on.
- Do not transmit when turning the POWER switch or the (rear panel) ATT switch on or off.
- When changing bands, always make certain that the FL-7000 is set for the same band as the transceiver before transmitting, and that the proper antenna is connected. If using the FAS-1-4R, remember that Antenna 1 is automatically selected when the FL-7000 is switched off.
- Reduce drive power or shorten transmissions if the PS TEMP or FAN indicators come on.

FL-7000 Microprocessor Resetting

Under certain conditions, one or both of the microprocessors in the FL-7000 can malfunction, causing the front panel LEDs to light at odd times or the START switches to be disabled. If this occurs, the microprocessor(s) should be reset by one or both of switches S6002 and S9201.

If the BAND and ANTENNA LEDs and the OPERATE and PROTECT LEDs appear to be malfunctioning, reset switch S6002.

If the START buttons is disabled and the READY, WAIT and WARNING LEDs appear to be malfunctioning, reset switch S9201.

To reset these switches, first turn the POWER switch off, and then set the reset switch(es) off. Then turn the POWER back on, followed by the reset switch(es).

The locations are S6002 and S9201 are indicated in the photos below.
Alignment

Each FL-7000 is carefully aligned at the factory, so realignment should not be necessary unless a major component failure occurs. Under no circumstances should realignment be attempted without the proper test equipment, and unless operation of the FL-7000 is fully understood, the malfunction carefully analyzed, and the fault definitely determined to be caused by misalignment. Sudden difficulties are almost always due to component failure, rather than misalignment. However, thorough familiarity with the circuitry sometimes allows measurements quoted in the alignment procedure to provide useful clues for troubleshooting. To further facilitate troubleshooting, voltage and frequency "check" steps have been included within the alignment procedures.

Test Equipment Required

- HF Transceiver: FT-747GX, FT-757GX, FT-767GX, FT-980, FT-990, FT-1000 or equivalent, providing 90 to 120 watts RF excitation in CW and SSB modes on 1.910 and 14.00 MHz.
- DC Voltmeter: with 50-V DC scale.
- DC Ammeter: with 1-A scale.
- Three 50-ohm, 1-kW Non-reactive Dummy Loads and connectors for putting them together in parallel; or one each 50-, 25- and 16.5-ohm 1-kW Dummy Loads.
- In-Line RF Wattmeter capable of 1 kW @ 14 MHz.
- 9-V DC Voltage Reference (9-V battery)

Preliminary Alignment Information

For those steps that require transmitter activation, set up the transceiver as described under Interconnections on pages 7 & 8.

Note!

Alignment by unauthorized persons may invalidate the warranty. Contact the selling dealer for instructions to obtain service under the warranty policy.
Connect the 1-kW dummy load and in-line RF wattmeter to the antenna jack on the rear panel for all alignment steps.

For those steps that call for transmitter activation, key the transmitter only after all controls have been set and test equipment connected, and then return to receive immediately after taking the reading or making the called-for adjustment.

Remember, although the DC supply voltage is not likely to cause injury, the RF voltage developed by the power amplifier can still be lethal.

Before connecting the FL-7000 to AC power, remove the top cover and confirm that the power transformer primary taps are set correctly for the AC voltage to be supplied during alignment, as shown on page 6.

Refer to the photograph below for locations of the alignment points referred to in the alignment procedures. Adjustment points referred to are prefixed as follows:

VR = trimmer potentiometer
TC = trimmer capacitor
TP = terminal post (test point)

The word "multimeter" in the alignment procedures refers to the multi-function (right-hand) meter on the FL-7000, while "ammeter" refers to the (left-hand) Collector Current meter on the FL-7000. "Test ammeter" refers to the external test equipment by that name. "In-line wattmeter" refers to the external wattmeter connected between the FL-7000 antenna jack and the dummy load(s).

**Note!**

Some adjustments of automatic sensing thresholds may trigger their respective functions before alignment can be made. If this occurs, reset the trimmer and repeat the procedure. In those cases where the PROTECT thresholds are set, the POWER switch must be turned off and on.
Alignment

**Alignment Procedures**

**VCC Setting & Meter Calibration**

- Connect the DC voltmeter (50-V scale) to the VCC terminal on the PS Unit, and press the VCC switch on the front panel.
- Set the SSB/RTTY switch to the SSB position, and adjust VR8002 on the PS Unit for 47V on the voltmeter.
- Adjust VR7010 on the Protector Unit for an indication of 47V on the front panel multimeter (corresponding to the 300 W mark on the PO scale).
- Press the SSB/RTTY button to select RTTY, and adjust VR8003 on the PS Unit for 32V on the voltmeter.

**Overcurrent Protector**

- Set the SSB/RTTY switch on the front panel to the SSB position.
- Mark the current position of the SSB ALC potentiometer on the rear panel (so that it can be reset to this position after alignment), and then turn the potentiometer fully clockwise.
- Press the OPERATE button and adjust VR7001 on the Protector Unit so that the ammeter (front panel meter at the left) is just at the threshold point where it begins to deflect (without transmitting).
- Set the transceiver and amplifier to 14.000 MHz, CW mode, and adjust the excitation for 500W output from the linear. Adjust VR7011 on the Protector Unit for an indication of 20 A on the front panel ammeter.
- Retune the equipment to 1.910 MHz, key the transmitter and adjust the SSB ALC potentiometer for 27 A on the ammeter.
- With the setup of the last step, key the transmitter and adjust VR8001 on the PS Unit very gradually so that the PROTECT indicator just starts to blink (the amplifier will shut down). Turn the POWER switch off and back on to reset.
- Return the SSB ALC potentiometer to the original (marked) position.

**Idling Current**

- Temporarily disconnect the wire from the VCC terminal on the PS Unit to the VCC terminal on the PA-1 Unit, and connect the test ammeter (set for 1 A f/s) in this line, ‘+’ to the PS Unit and ‘-’ to the PA-1 Unit.
- Set the transceiver and FL-7000 to 14.000 MHz SSB mode, and set the MIC gain control on the transceiver fully counterclockwise (no drive). With the OPERATE button depressed, key the transmitter, *wait sixty seconds*, and then adjust VR2001 on the PA-1 Unit for 100 to 150 mA on the test ammeter.
- Remove the test ammeter and replace the VCC connection to the PA-1 Unit. Then repeat these steps with the PA-2 Unit, adjusting VR3001 on the PA-2 Unit.

**CM Coupler Balance**

- With the transceiver and FL-7000 set to 14.000 MHz, CW mode, set the OPERATE and SWR switches to the depressed position, and the TUNER switch to the undepressed (off) position.
- Key the transmitter, and with full output power, adjust TC5001 on the LPF Unit for minimum deflection on the multimeter (indicating SWR).

**ALC Calibration and Setting**

- With the transceiver and FL-7000 set to 14.000 MHz, USB mode, set the OPERATE and ALC switches to the depressed position, and the TUNER switch to the undepressed (off) position.
- Apply the +9V DC voltage reference to TP7001 on the Protector Unit.
- With minimum excitation (MIC gain fully counterclockwise), adjust VR7008 on the Protector Unit so that the FL-7000 multimeter deflects exactly to the right edge of the ALC zone.
- Now adjust VR7005 on the Protector Unit very gradually so that the PROTECT indicator just starts to blink, and the amplifier shuts down.
- Return to receive, remove the 9V reference, and turn the FL-7000 POWER switch off and back on to reset.
- Switch the transceiver to CW mode, and set the transceiver drive control for full power. Key the transmitter and adjust VR7002 for 500 W on the in-line wattmeter.
- Install the second 50-ohm dummy load in parallel with the first, to provide a 25-ohm load. Key the transmitter and adjust VR7003 for 300W on the in-line wattmeter.

**SWR Metering**

- With the transceiver and FL-7000 set to 14.000 MHz, CW mode, set the OPERATE and SWR switches to the
dep essed position, and the **TUNER** switch to the un-

depressed (■) position.

- Connect the 16.5-ohm dummy load (or three 50-ohm
  loads in parallel) to the antenna jack with the in-line
  wattmeter.

- Apply maximum CW excitation from the transmitter,
  and adjust VR7006 on the Protector Unit for mini-
  mum deflection on the FL-7000 multimeter (showing
  SWR).

- Adjust VR7009 on the Protector Unit for an SWR
  indication of exactly '3' on the multimeter.

**SWR Protection Calibration**

- With the equipment set up and connected as in the
  first two steps of the previous procedure, apply max-
  imum excitation and adjust VR7004 on the Protector
  Unit very gradually until the **PROTECT** indicator blinks
  and the amplifier shuts down. Turn the **POWER** switch
  off and on to reset.

**PO Meter Calibration**

- With the transceiver and FL-7000 set to 14.000 MHz,
  CW mode, set the **OPERATE** and **PO** switches to the
  depressed position, and the **TUNER** switch to the un-
  depressed (■) position.

- Connect one 50-ohm dummy load with the in-line
  wattmeter to the antenna jack. Key the transmitter and
  adjust the exciter drive for 500 W output on the in-line
  wattmeter.

- Key the transmitter and adjust VR7007 on the Protec-
  tor Unit for 500 W indication on the PO scale of the
  FL-7000 multimeter.

**ATU Sensitivity**

- With the transceiver and FL-7000 set to 14.000 MHz,
  CW mode, set the **TUNER** and **SWR** switches to the
  depressed position, and the **OPERATE** switch to the
  undepressed (■) position.

- With the 50-ohm dummy load and in-line wattmeter
  connected to the antenna jack, apply maximum exci-
  tation and manually tune the FL-7000 **LOAD** and **TUNE**
  keys for 1:1 SWR on the multimeter.

- Replace the 50-ohm dummy load with 25 ohms (two
  50's in parallel). Then key the transmitter and adjust
  VR9203, if necessary, so the **WAIT** indicator comes on
  (the ATU starts automatic tuning).
DIVIDER UNIT
F2773000 (No.1xxx)

RESISTOR VALUES ARE IN Ω, 1/4W;
CAPACITOR VALUES ARE IN μF, 50v;
UNLESS OTHERWISE NOTED.

POWER COMBINER UNIT
F2772000 (No.4xxx)

RESISTOR VALUES ARE IN Ω, 1/4W;
CAPACITOR VALUES ARE IN μF;
UNLESS OTHERWISE NOTED.
LPF UNIT
F2774000 (No.5xxx)

DIODES ARE TYPE 1S1555 UNLESS OTHERWISE NOTED
RESISTOR VALUES ARE IN Ω, 1/4W
CAPACITOR VALUES ARE IN µF, 50VDC
INDUCTOR VALUES ARE IN HENRIES
UNLESS OTHERWISE NOTED.
RESISTOR VALUES ARE IN Ω, 1/4W.
CAPACITOR VALUES ARE IN µF, 50V.
UNLESS OTHERWISE NOTED.
Alignment

1. Connect the FL-5 ohm dummy load (or three 50-ohm loads in parallel) to the antenna jack with the in-line transformer.
2. Connect one 50-ohm dummy load to the antenna jack with the in-line transformer (or a 50-ohm load transformer).
3. Key the transceiver and set the ATU for 50% on the SWR meter.
4. Adjust VFO004 on the Processor Unit for an SWR indicator of exactly "S" on the meter.

SWR Protection Calibration

5. With the equipment set up and connected as in the first two stages of the previous procedure, apply maximum excitation and adjust VFO004 on the Processor Unit very gradually until the PRTATT indicator lights and the amplifier stats down. Try 15 minutes with the power off and on to check.

PO Meter Calibration

6. With the transceiver and FL-7000 set to CW mode, set the OVerST and OFF switches to the depressed (OFF) position.
7. Connect one 50-ohm dummy load to the antenna jack with the in-line transformer.
8. Replace the 50-ohm dummy load (50's in parallel). This should be the VFO003, if necessary (the ATU starts calibrating).