

INSTRUCTION MANUAL

FL-2100F

YAESU MUSEN CO., LTD.

TOKYO, JAPAN

FL-2100F LINEAR AMPLIFIER



GENERAL

The FL-2100F Linear Amplifier is designed to match the FT-101F transceivers in appearance and performance. It is also fully compatible with the FT-901 series of transceivers, and will function well with the FT-301D transceiver through connection by way of the optional Relay Box for the FT-301D.

The FL-2100F uses a pair of 572B/T160 transmitting triodes in a Class B grounded grid configuration. Operation is possible on the amateur 80 through 15 meter bands.

The tubes use forced-air cooling, which is provided by two quiet, high speed internal fans. An Automatic Level Control (ALC) circuit controls the exciter gain, allowing high average power without distortion caused by peak clipping. An internal changeover circuit biases the tubes to cutoff during receive, eliminating unwanted heat and diode noise generation.

An internal relay feeds the antenna through to the exciter for low power operation when the amplifier is turned off or in the standby condition. A built-in SWR bridge measures SWR during both amplifier and exciter-only operation.

The built-in solid-state power supply requires no warmup period, and provides excellent voltage regulation.

We highly recommend that you read this manual thoroughly before commencing operation of the FL-2100F. While operation is quite straightforward, improper adjustment of the controls may lead to reduced output and/or damage to components.

SPECIFICATIONS

Circuit type:	Class B Grounded Grid
Frequency coverage:	Amateur 80, 40, 20, and 15 meter bands
Plate input power:	1200 watts PEP, 1000 watts CW, 400 watts AM/FM/FSK
Plate voltage:	2400 VDC
Drive requirements:	100 watts PEP for full output
Input impedance:	50 ohms, unbalanced
Output impedance:	50 - 75 ohms, unbalanced
Third order distortion products:	-31 dB or better @ 1 KW PEP
Tube complement:	2 x 572B/T160
Cooling system:	Forced-air
Power requirements:	AC 100/110/117 volts, 50/60 Hz, 18 amps 200/220/234 volts, 50/60 Hz, 9 amps
Dimensions:	13-1/2" (W) x 6" (H) x 11-1/2" (D)
Weight:	41 lbs.

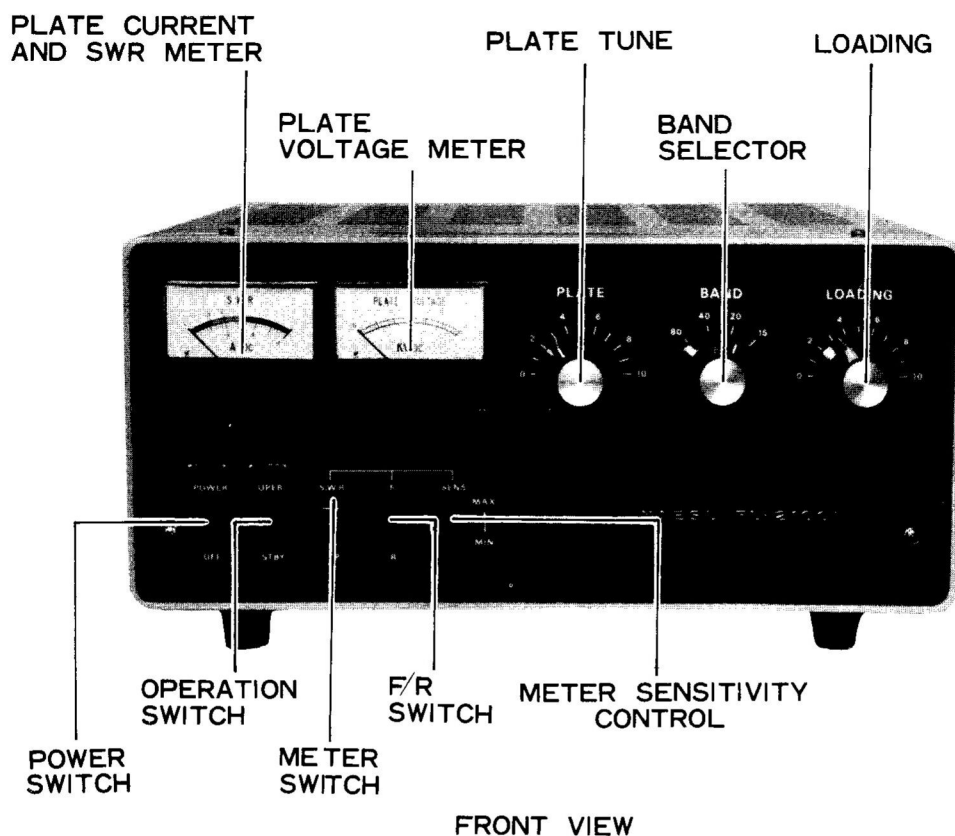
Specifications subject to change without notice.

CAUTION

HIGH VOLTAGES ARE PRESENT WITHIN THE CABINET OF THIS APPARATUS. HARMFUL OR FATAL ELECTRIC SHOCK WILL RESULT IF HIGH VOLTAGE CIRCUITS ARE TOUCHED BY THE USER. REFER ALL SERVICE WORK TO AN EXPERIENCED TECHNICIAN.

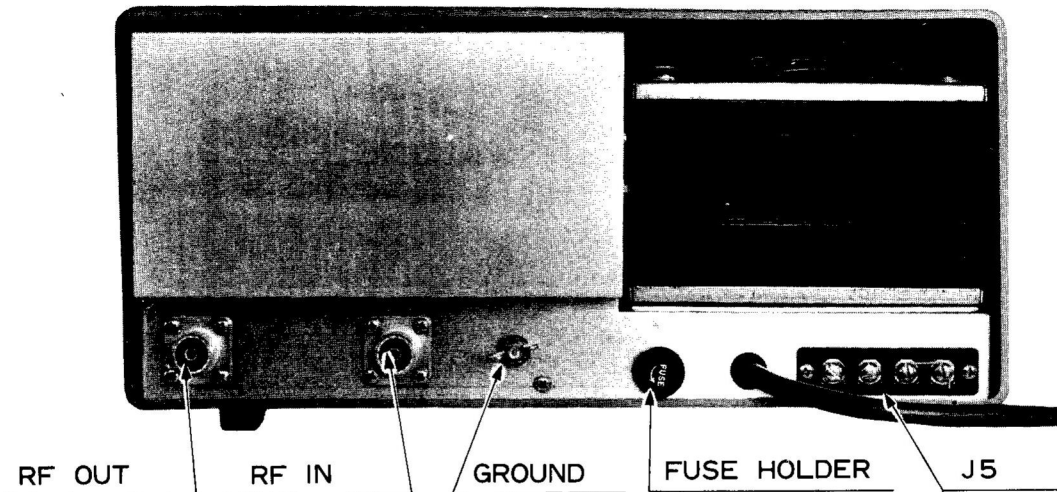
DO NOT TURN ON THE FL-2100F WITH THE TOP SHIELD COVER REMOVED. THE HIGH VOLTAGE SAFETY INTERLOCK SHORTS OUT THE HIGH VOLTAGE LINE, AND DAMAGE TO THE POWER SUPPLY CIRCUITRY WILL RESULT.

FRONT PANEL CONTROLS



- POWER/OFF:** Rocker switch turns power on and off.
- OPER/STBY:** Rocker switch applies bias on standby, and relay is disengaged.
- SWR/IP:** Rocker switch selects either SWR or plate current meter indication.
- F/R:** Rocker switch selects either forward or reflected SWR meter indication.
- SENS:** Potentiometer adjusts the meter sensitivity for SWR measurement.
- PLATE:** This knob adjusts the tuning of the plate tank capacitor.
- LOAD:** This knob adjusts the tuning of the loading capacitor.
- BAND:** This knob selects the band in use.

REAR APRON CONNECTIONS



REAR VIEW

- RF OUT:** RF output to antenna.
- RF IN:** RF input from transceiver.
- GND:** Ground connection.
- FUSE:** Fuse holder. For 200 - 234 volt operation, use a 20 amp fuse. For 100 - 117 volt operation, use a 15 amp fuse. Do not replace blown fuses with a fuse of improper rating.
- CONTROL CONNECTIONS:**
- E — Ground connection (common).
 - ALC — Automatic level control to transceiver.
 - E — Empty connector (no connection).
 - RY — Relay connection to transceiver. Use a normally open relay. Remove the jumper for relay operation.

INSTALLATION

UNPACKING

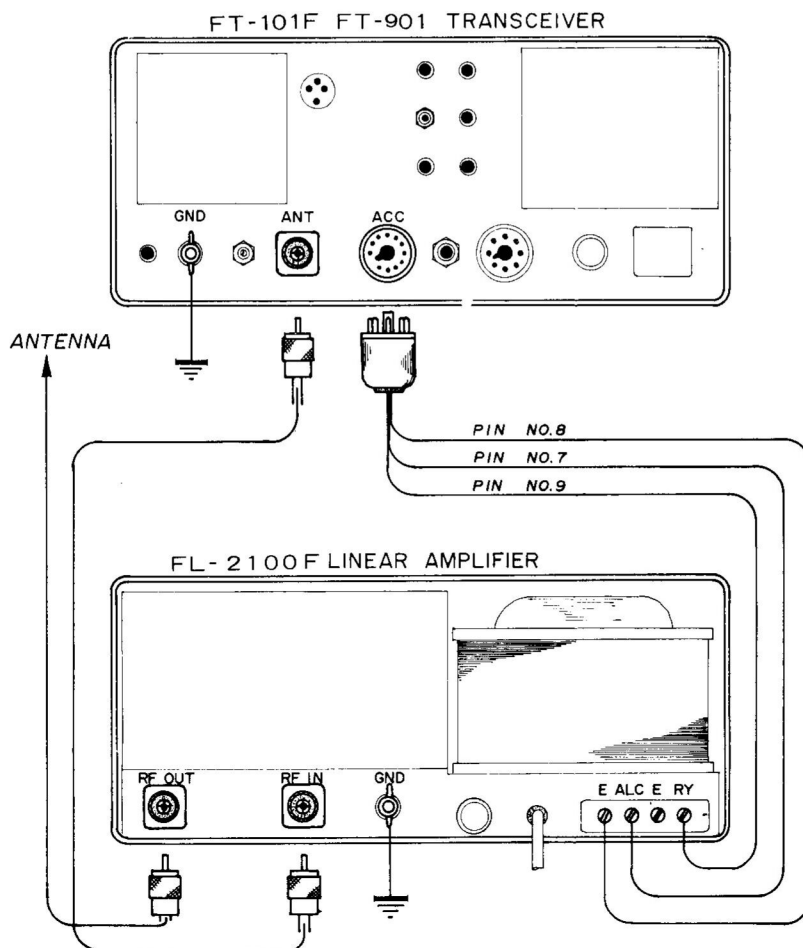
Carefully remove the FL-2100F from the packing carton and examine the unit for any signs of visible damage. Check the knobs and switches for complete freedom of action. If any damage has occurred in shipment, notify the shipping company at once and document the damage completely.

INTERCONNECTION

In general, the amplifier should be located in such a way as to ensure free air circulation around the cabinet. Do not place books, papers, or other equipment on top of the FL-2100F, and do not place papers or other material under the bottom of the amplifier cabinet.

Refer to the drawing for interconnection details to the FT-101F. The ALC connection to the exciter should be made to ensure a clean output signal. The jumper wire across the RY and E terminals is installed at the factory for testing purpose, and it should be removed prior to attempting operation. The relay circuit in the FL-2100F requires a normally open relay in the exciter for proper operation. On transmit, the exciter relay is closed, and the amplifier is activated.

In general, the exciter to be used (if other than the FT-101F) should be capable of producing 100 watts PEP SSB output. The exciter and amplifier should be located together, if only to prevent long cable runs and to facilitate tuning.



POWER REQUIREMENT

The FL-2100F has a built-in power supply capable of operation from 100/110/117/200/220/234 volts AC, 50/60 Hz. Before attempting operation, be absolutely certain that the voltage specification marked on the rear apron matches your local line voltage. OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY APPLICATION OF IMPROPER AC LINE VOLTAGE.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE TRANSCEIVER.

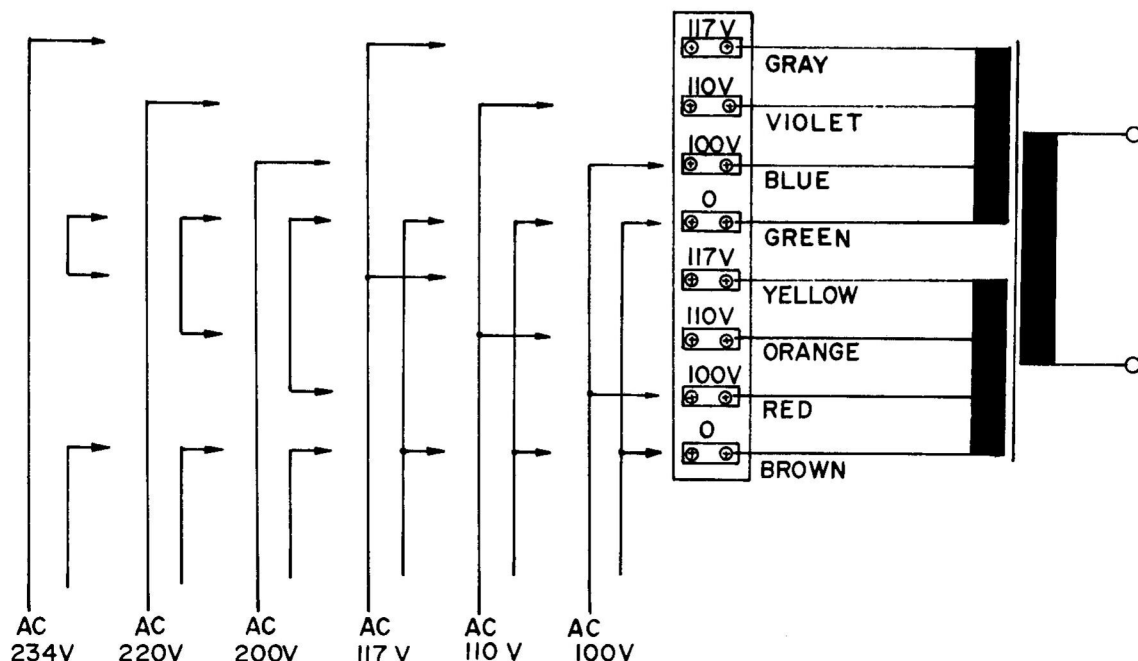
If at all possible, the FL-2100F should be operated from its own 220 volt AC line. The line should be fused for 10 amperes, and no other appliances should be run off the same circuit. The fuse in the FL-2100F should be rated at 15 amperes for 220 volt operation.

If a 117 volt circuit is all that is available, it should be fused for 20 amperes, and circuit conductors should be no smaller than #10 AWG. No other appliances should be operated from this circuit. UNDER NO CIRCUMSTANCES should the FL-2100F be operated from a 117 volt house lighting circuit, as the circuit conductors are not large enough to carry this load. For 117 volt operation, the FL-2100F fuse should be rated at 20 amperes.

CAUTION

BE ABSOLUTELY TO USE A FUSE OF THE PROPER RATING (15 AMPERES FOR 200/220/234 VAC, 20 AMPERES FOR 100/110/117 VAC). OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY USE OF AN IMPROPER FUSE.

Refer to the transformer wiring diagram for details on the proper connections for various line voltages.



POWER TRANSFORMER PRIMARY CONNECTIONS

ANTENNA REQUIREMENTS

The FL-2100F has been designed for use with an antenna resonant at the operating frequency, and having an impedance between 40 and 80 ohms. The nominal output impedance of the FL-2100F is 50 ohms. When using an antenna of an impedance which is far from this figure, we recommend the use of an antenna matching network to bring the impedance of the antenna system within the operating range of the amplifier.

GROUND

The FL-2100F should be connected to a good earth ground. Use a heavy gauge ground strap for this purpose, and make the strap as short as possible for best performance and maximum safety. The connection should be made to the post marked GND on the rear apron.

CAUTION

NEVER OPERATE THE FL-2100F WITHOUT CONNECTING IT TO A GOOD EARTH GROUND. LIKEWISE, NEVER OPERATE THE AMPLIFIER WITHOUT AN ANTENNA OR DUMMY LOAD CONNECTED.

OPERATION

BEFORE COMMENCING OPERATION, BE CERTAIN THAT THE AMPLIFIER IS CONNECTED TO A 50 OHM ANTENNA SYSTEM OR DUMMY LOAD, AND THAT THE TRANSFORMER IS CORRECTLY WIRED FOR THE LINE VOLTAGE IN USE. BE CERTAIN THAT A FUSE OF THE PROPER RATING IS USED FOR THE LINE VOLTAGE IN USE.

The exciter may be tuned up with the amplifier turned off, or with the amplifier turned on and the operation switch in the STBY position. Once the exciter has been tuned up, place it in the standby condition.

Preset the FL-2100F controls as follows:

POWER switch	OFF
OPER/STBY	STBY
SWR/IP switch	IP
BAND switch	Desired band
PLATE control	To the number shown in Table 1.
LOAD control	Fully counterclockwise to number 0.

Turn the FL-2100F power switch to ON, and wait a few seconds for the tubes to warm up. Place the operation switch in the OPER position.

Apply drive from the exciter, and increase its output until a reading of 0.2 amps is obtained on the FL-2100F. Tune the amplifier PLATE control for a dip (minimum meter reading) in the plate current. Return the exciter to standby.

Place the FL-2100F meter switch in the SWR position, and the F/R switch to F (to read forward power). Turn on the exciter, and adjust the SENS control for a reading of approximately 1/4 scale. Now advance the LOAD control in small increments, each time tuning the PLATE control for a maximum forward power reading. Adjust the SENS control as necessary to prevent off-scale indication on the meter as power is increased.

DO NOT EXCEED 10 SECOND KEY DOWN TIME DURING TUNE UP, TO PROTECT THE EXCITER AND AMPLIFIER TUBES.

Peak power output should occur at a plate current (IP) reading of approximately 0.5 amperes. Approximate settings of the LOAD control for maximum output into a 50 ohm load are shown in Table 1.

When tuning, be certain to start at a very low drive level, and keep the plate current dipped. Likewise, do not begin tuning with the LOAD control advanced beyond the 0 point. The correct technique is to increase the exciter drive only after an initial dip is obtained in the plate current. With proper care taken in tuning, your FL-2100F will provide many years of trouble-free operation.

The amplifier is now tuned for SSB and CW operation. For SSB operation, the exciter should be adjusted so that the FL-2100F plate current meter indicates between 0.2 and 0.3 amperes under normal voice operating conditions. As the meter cannot follow the current flow corresponding to the speech signal, the actual peak current value is approximately twice the value read on the meter.

For AM operation, tune up the FL-2100F as described previously. The exciter should be adjusted for a plate current indication of 0.2 amps with unmodulated carrier. If an exciter capable of FM or FSK operation is used, do not exceed the ratings stipulated for AM operation.

To measure the SWR at the antenna jack, set the meter switch to SWR, and apply RF power. Adjust the meter SENS control until a full scale deflection is obtained (not off scale) with the F/R switch in the F position. Now turn the F/R switch to the R (reflected) position. The SWR may be read directly from the upper scale of the meter.

BAND	PLATE	LOADING
80	1 — 6.5	1.5 — 5.5
40	6 — 7	3
20	7 — 8	3.5
15	9 — 9.5	4

Table 1

THEORY OF OPERATION

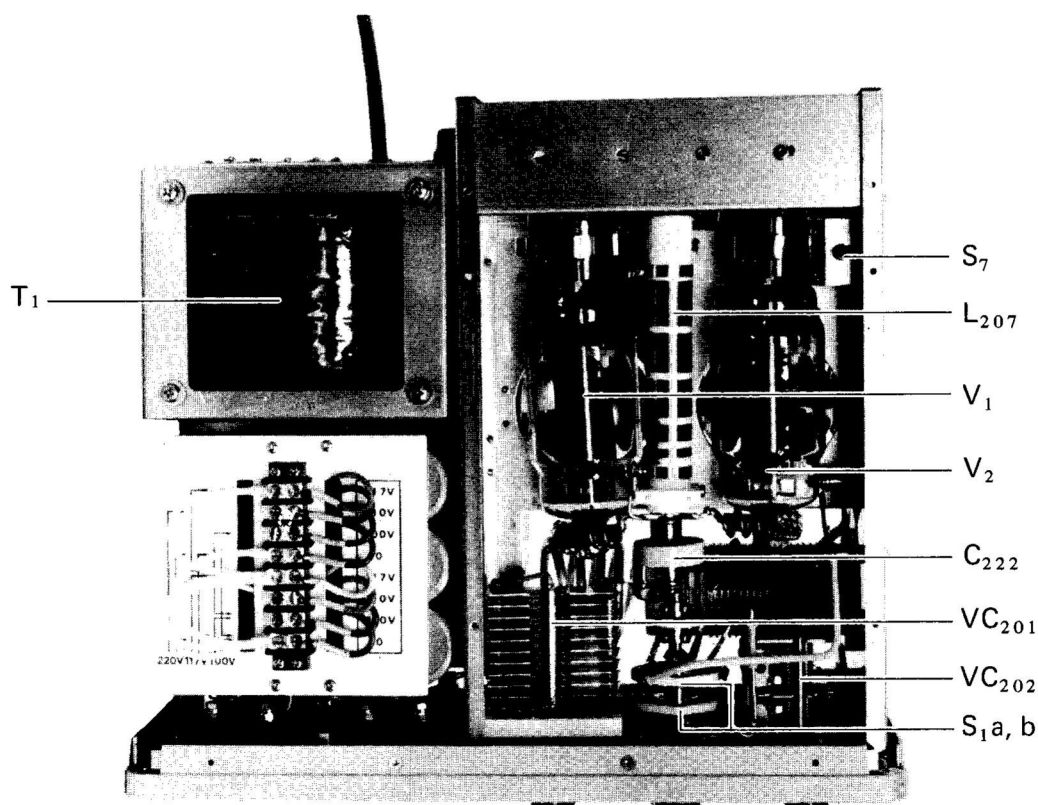
The FL-2100F uses two 572B/T160 zero bias triodes in a class B grounded grid configuration.

RF driving power from the exciter is applied to the tube filaments through the antenna changeover relay and an input pi network. The input circuits for each band are selected by the input switch S2B, which is ganged to the BAND switch, S₁.

The RF voltage appearing on the grids of the tubes is coupled through C₂₀₃ to ALC rectifier diodes D₂₀₁ and D₂₀₂ (1S1007). The plate potential at D₂₀₁ is determined by R₁, R₂, and R₃, so that adequate ALC voltage is available for control of the exciter.

The bias level is set by R₄. When the antenna relay is switched to the transmit condition, a timing circuit controls RL₃₀₁ to keep the tubes biased to cutoff until the antenna changeover relay is firmly seated. This protective feature prevents an unloaded condition from occurring caused by the travel time of the antenna relay. In standby, the cold end of S₄ is opened, biasing the tubes to cutoff.

The plate circuit is coupled to the 50 ohm output load by an adjustable pi network. A 50 ohm SWR bridge circuit allows monitoring of forward and reflected relative power.



TOP VIEW

SERVICING AND MAINTENANCE

WARNING: LETHAL VOLTAGES ARE PRESENT WITHIN THE CABINET. BEFORE REMOVING THE CABINET, UNPLUG THE POWER CORD FROM THE AC SUPPLY. USE EXTREME CAUTION WHENEVER MAKING ANY ADJUSTMENTS INSIDE THE CABINET.

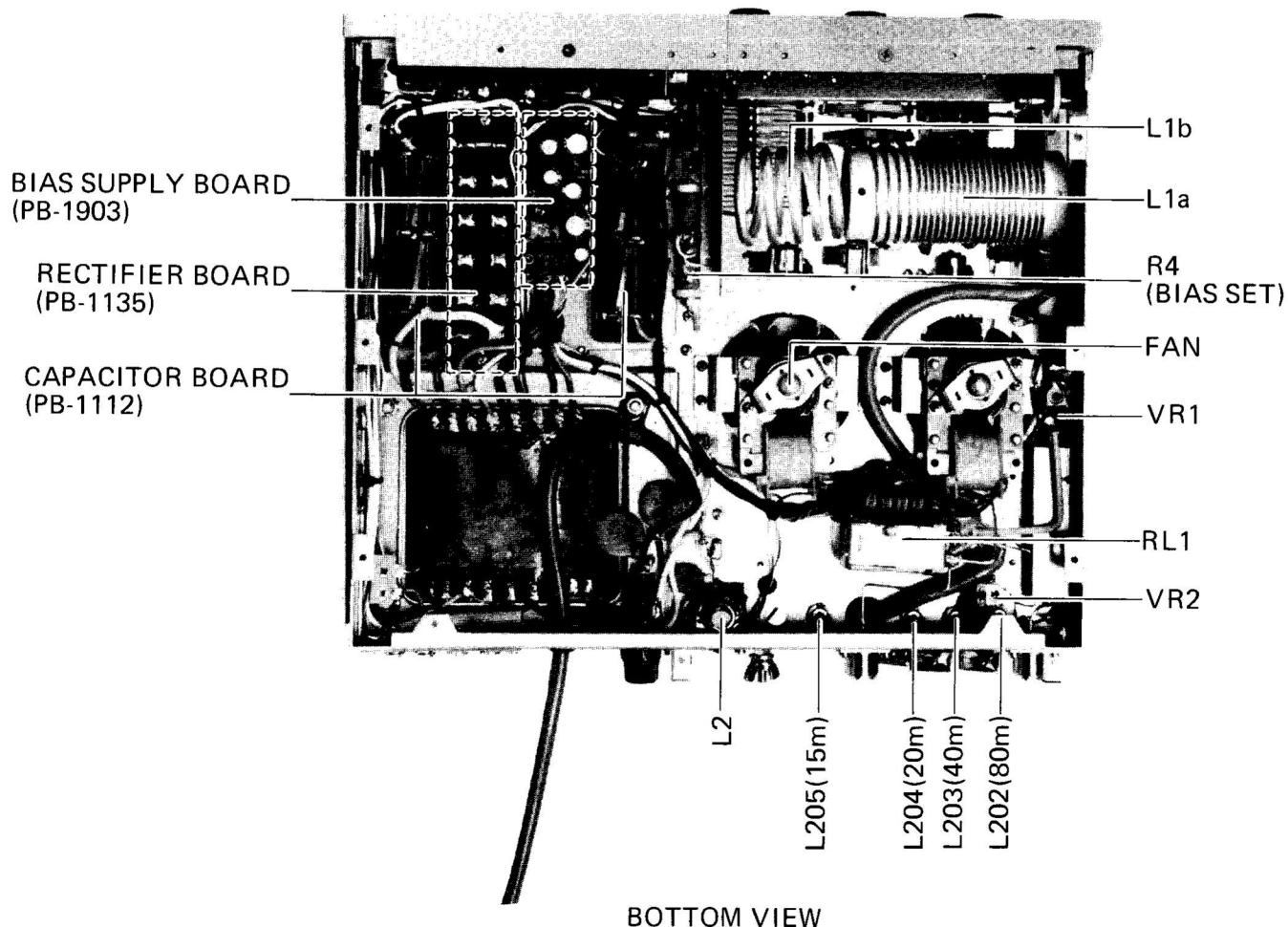
REMOVAL OF BOTTOM COVER AND CABINET

After disconnecting the power cord from the AC supply line, the bottom cover can be removed by removal of the four connecting screws.

The chassis and panel assembly is removed from the remainder of the cabinet as follows: remove the screws on the bottom of the cabinet as well as the four cabinet screws near the front of the amplifier. Once the screws are removed, the cabinet can be eased out backwards from the chassis and panel assembly.

REMOVAL OF THE SHIELD COVER

After the cabinet is removed, the shield cover on the PA compartment may be removed by taking off the screws on the shield cover. The safety lock shorts out the filter capacitors, and AC power must not be applied with the shield cover removed.



TUBE REPLACEMENT

If replacement of the amplifier tubes becomes necessary, use tubes of identical manufacture as the originals. See your Yaesu dealer.

TROUBLESHOOTING

Should trouble arise which cannot be cured by tube substitution, we recommend that the unit be returned to the dealer from whom you purchased it for servicing. If this is impossible, write to us in detail, and we will advise you as to the best course of action. Under no circumstances should troubleshooting or servicing be attempted by anyone other than a technician experienced in high-power RF devices.

INPUT COIL ALIGNMENT

The input coils are adjusted at the factory for the center of each band, and are broad enough to cover the entire frequency range specified. However, if the tubes are replaced with a brand other than those originally supplied, alignment of the input coils may be necessary.

Connect a 50 ohm SWR meter between the exciter output and the RF input jack of the FL-2100F. Disconnect the FL-2100F from the AC power line. Remove the cabinet of the amplifier as described previously. Disconnect the wiring from the high voltage terminals of the power transformer.

Connect the amplifier to the exciter in the same manner as for normal operation, except for the SWR meter in the input line.

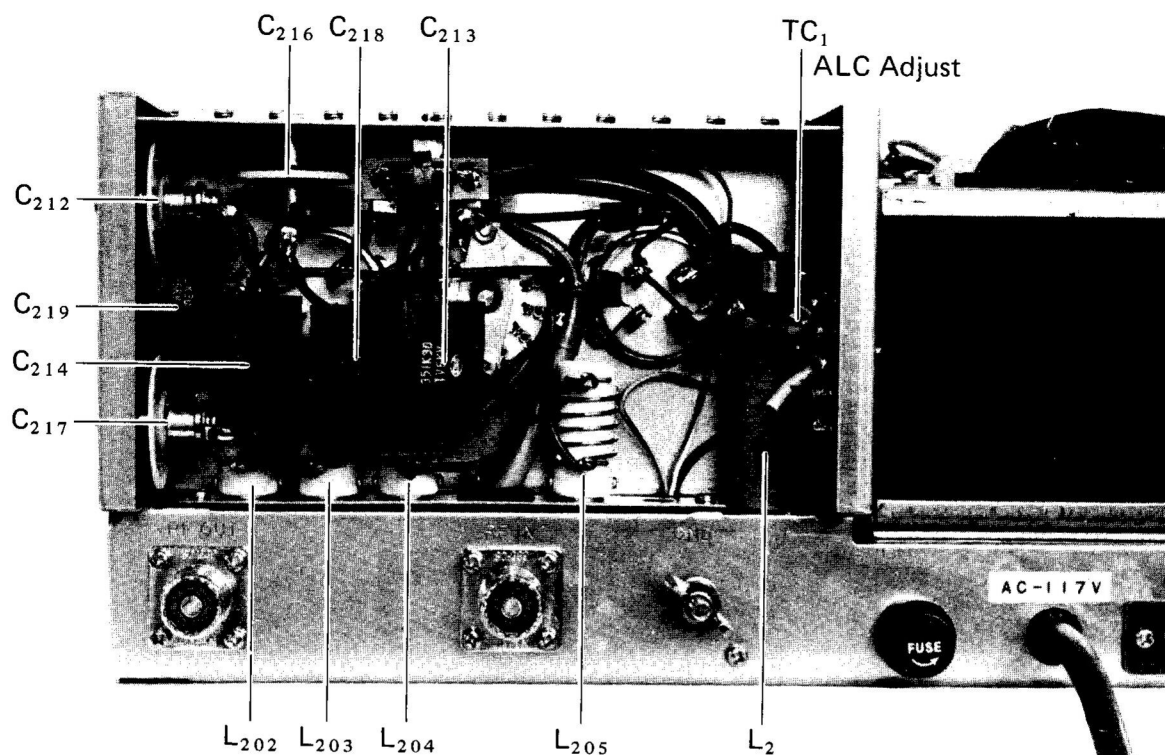
Preset the controls on the FL-2100F as follows:

BAND switch Desired band
LOAD control Fully counter-clockwise
PLATE control To the position shown in Table 1.

Tune up the exciter on CW in the middle of the band to be aligned. Turn on the amplifier; it will now be operating without plate voltage. USE EXTREME CAUTION, AS HIGH VOLTAGE IS STILL PRESENT ON THE SECONDARY TERMINALS OF THE POWER TRANSFORMER.

Apply drive from the exciter, and increase the drive level until the FL-2100F IP reading is 0.1 amperes. Tune the PLATE control for a dip in the plate current. Tune the slug on the appropriate input coil for a minimum reflected power reading on the input line SWR meter. Repeat this procedure on each band.

After alignment, disconnect the power cord from the AC line, and reinstall the disconnected high voltage wiring to the transformer secondary terminals.



INPUT TUNING CIRCUIT COMPARTMENT

BIAS LEVEL ADJUSTMENT

With the function switch in the OPER position, activate the amplifier relay with no RF drive applied. The meter IP indication should be 0.09 amps. If the reading is different than this, adjustment of the bias is required.

Remove the bottom cover of the amplifier. Turn the amplifier on, and activate its relay. Adjust R_4 for an idling current of 0.09 amps.

PARTS LIST

MAIN CHASSIS			TERMINAL BOARD		
Symbol No.	Parts No.	Description	J2	69040003	ML3391-8P
		DIODE	J5	69040001	T3507-4P
D2, 3	21010070	Germanium 1S1007		90110000	1L1P (1-0)
				90110001	1L2P (1-0-1)
				90120002	1L4P (2-0-2)
		RESISTOR		90010001	1L2P(S) (1-0-1)
R2	42124222	Carbon composition 1/2W GK 2.2k Ω		90020002	1L4P(S) (2-0-2)
R1	43204224	Metallic film 2W 220k Ω			
R4	46116300	Wire wound variable 10W 30 Ω (RWH-10A1)			
R3 (with M1)	—	Shunt resistor	SUB CHASSIS		
R5 (with M2)	—	Series resistor 2W 1.5M Ω	Symbol No.	Parts No.	Description
					VACUUM TUBE
			V1, 2	10000025	572B/T160
		POTENTIOMETER			
VR1, 2	49901501	EVL-S3A 00B53 500 Ω B			VACUUM TUBE SOCKET
VR3	49205104	EVH-BOAS 15B15 100k Ω B	VS1, 2	68040002	S501-UX
		CAPACITOR			DIODE
C3, 4, 7-10	30830103	Ceramic disc 500WV 0.01 μ F (ECK-D2H 103PE)	D201	21010070	Germanium 1S1007
C1, 2	30240103	" " 1.4kV 0.01 μ F (ECK-DAL 103PE)	D202	21019430	Silicon 1S1943
					RESISTOR
		POWER TRANSFORMER	R204	42124472	Carbon composition 1/2W GK 4.7k Ω
PT1	52000023	SA2-10550	R203	43104332	" " 1W " 3.3k Ω
			R205, 206 (L208, 209)	42204220	" " 2W " 22 Ω
		METER	R201, 202	42204330	" " " " 33 Ω
M1 (with R3)	74000100	PF45 (F.S 1mA/600mA)	R207	43204473	Metallic film " 47k Ω
M2 (with R5)	74000110	PF45 (F.S 3kV)			
					CAPACITOR
			C203	33831050	Dipped mica 500WV 5pF
		RELAY	C201, 202	33834201	" " " 200pF
RL1	70926302	AW5221GK	C205-208, 210, 225	30830103	Ceramic disc " 0.01 μ F (ECK-D2H 103PE)
			C224	32440101	" RDA-30 3kV 100pF
		SWITCH	C216	32440201	" " " 200pF
S3, 4	64000003	WD 9223	C212, 217	32440251	" " " 250pF
S5, 6	64000004	WD 9216	C226	32440301	" " " 300pF
S7	80011680	Safety switch ass'y	C223	32440501	" " " 500pF
			C221, 222	32440102	" " " 1000pF
			C213	33447351	Moulded mica 6kV 350pF (CMBS-351K30)
		FAN MOTOR	C218	33447401	" " " 400pF (CMBS-401K30)
FAN1, 2	75000002	2S10A (with fan)	C214	33447501	" " " 500pF (CMBS-501K30)
			C219, 220	33447102	" " " 1000pF (CMBS-102K30)
		LAMP			
PL1, 2	14000025	BQ054-32732A			
		FUSE			VARIABLE CAPACITOR
F1	73000007	20A (100V-117V)	VC201	39551111	YA114P 115pF (MAX).
	73000006	15A (200V-234V)	VC202	39520002	ECV-2HA43A44 430pFx2
		FUSE HOLDER			TRIMMER CAPACITOR
FH1	69030001	SN 1001 #2	TC201	39000005	ECV-1ZW 50x32 50pF
		ANTENNA RECEPTACLE			INDUCTOR
J3, 4	68000007	JSO-239	L1a	55002270	#001188
			L1b	55002350	#001556A

L202	55002230	(80m) #001194A-80			
L203	55002240	(40m) " -40			
L204	55002250	(20m) " -20			CAPACITOR
L205	55002260	(15m) " -15	C305	34120337	Electrolytic 10WV 330μF (RL)
L207	55002280	Plate choke #001557B	C306	34220107	" 25WV 100μF (RE)
L201 (R203)	55002220	Grid P.S #001191	C301, 304	34320477	" " 470μF (RE)
L208, 209 (R4, R5)	55002290	Plate P.S #001192B	C302, 303	34920476	" 63WV 47μF (RL)
L2	55002210	Filament choke #001190			
L3	54000040	RF choke 300μH			RELAY
			RL301	70000031	FBR211AD-012M
		BAND SWITCH			
S1,	61000580	RS40C 2-2-4			
S2	61000590	RS32C 1-3-4			
		PLATE CAP			
PC1, 2	79000006	HV-300 / L 100A			
	92000002	SHAFT JOINT C2			
		RECTIFIER BOARD			
PB-1135	60511350	Printed Circuit Board			
	011350AZ	P.C.B. with components			
		DIODE			
D101-110	21090019	Silicon 10D10			
		RESISTOR			
R101-110	42124474	Carbon composition 1/2W GK 470kΩ			
		CAPACITOR BOARD			
PB-1112	60311120	Printed Circuit Board			
	011120AZ	P.C.B. with components			
		RESISTOR			
R111-115	43204224	Metallic film 2W 220kΩ			
		CAPACITOR			
C101-106	34839107	Electrolytic 500WV 100μF (ECE-M 500V 100E)			
		BIAS SUPPLY BOARD			
PB-1903	60419030	Printed Circuit Board			
	019030AZ	P.C.B. with components			
		DIODE			
D301-305	21090011	Silicon 10D1			
D306	21090019	Silicon 10D10			
		RESISTOR			
R304	42124151	Carbon composition 1/2W GK 150Ω			
R303	42124473	" " " " 47kΩ			
R305	43104330	Metallic film 1W 33Ω			
R301, 302	43204560	" " 2W 56Ω			