

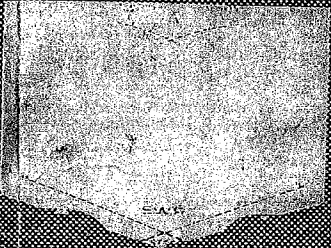
Serial # F10016

HOBBY ELECTRONICS

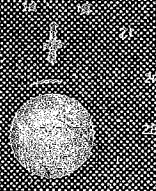
**DAIWA**

**AUTOMATIC ANTENNA TUNER MODEL CNA-2002**

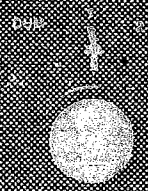
CNA-2002 2-MW PER ANTENNA TUNER



BAND



ANTENNA



DAIWA

FINE TUNING



FINE TUNING



OFF	LINE	RANGE	TUNER
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# WARNING

1. *Do not* use speech processing when operating at high power levels. The average and peak power levels produced can exceed the specification ratings of the CNA2002/CNW518.
2. *Do not* exceed the legal power limits for the particular mode used (CW, SSB, etc.). Always take care to keep your output level within legal limits.
3. *Never* attempt automatic or manual tuning at power levels greater than 50 watts.
4. (For CNA2002 owners only) Check the input level switch on the rear of the unit and set it for the normal power level you will be using for automatic tuning.

**FAILURE TO OBSERVE ANY OF THE ABOVE MAY CAUSE IMMEDIATE AND SEVERE DAMAGE TO YOUR TUNER—REPAIR OF WHICH WILL NOT BE COVERED BY YOUR WARRANTY.**

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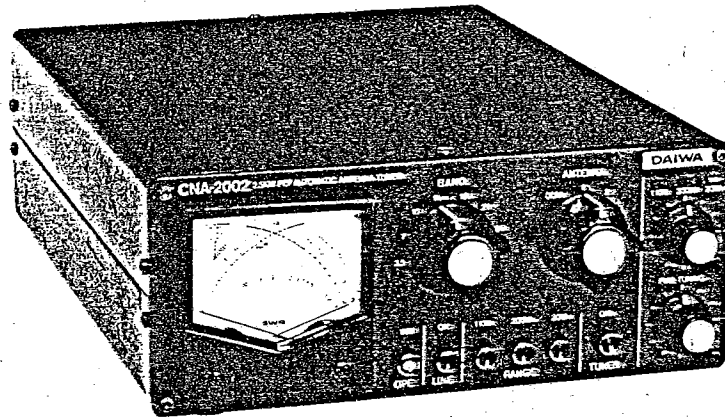
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### ① GENERAL

The Daiwa Automatic Antenna Tuner model CNA-2002 marks an major advance in amateur radio. For the first time, the radio amateur is offered a high power automatic antenna tuner which will reduce the SWR to less than 1.5:1. This new development is made possible by Daiwa's advanced technology coupled with long experience in this field.

### ② FEATURES

1. Light, compact and high power Automatic Antenna Tuner, the model CNA-2002 is now available. In spite of it's small size, high voltage variable capacitors are equipped (TV 6kV).
2. A troidal core current transformer is used for the detection of Forward power and Reflected power. SWR measurement with very good frequency response between 3.5 - 30 MHz is assured.
3. The unique Daiwa cross needle meter is fitted on the front panel. It can read Forward power, Reflected power and SWR at a glance.
4. A Pi network is employed as the tuner circuitry which substantially reduces harmonics radiation and TVI. (The band pass effect of the CNA-2002 is shown in Fig-12.)
5. Two Fine Tuning controls are equipped in parallel with main variable capacitors. These can be adjusted manually to 1:1 SWR ratio, after the circuit has tuned automatically to the SWR of approximately 1.5:1. Variation of antenna impedance at band-edges is easily compensated.
6. The built-in dummy load can be used for tuning the transmitter. (100W, 1 min. rating.).



### 3 SPECIFICATIONS

#### SWR/Power meter circuitry

1. Frequency coverage	.....	1.8 - 30 MHz
2. Input/Output impedance	.....	50 ohm
3. Power rating	.....	1 kW CW
4. Meter scale ratio, Forward vs Reflected power	.....	5:1
5. Power range	.....	Forward power: 20/200/1000 W
"    "	.....	Reflected power: 4/40/200 W
6. Meter accuracy	.....	±10% (at full scale)
7. SWR measuring range	.....	1:1 - infinity
8. SWR detection sensitivity	.....	4W

#### Tuner Circuitry

1. Frequency	.....	3.5, 7, 10, 14, 18, 21, 24, 28 MHz
2. Input impedance	.....	50 ohm (unbalanced)
3. Output impedance	.....	25 - 100 ohm (unbalanced) on 3.5 MHz
	.....	10 - 250 ohm (unbalanced) 7 - 28 MHz
	.....	at VSWR below 1.5:1.
4. Power rating	.....	CW: 1kW (50% duty)
	.....	SSTV, RTTY: 500W (10 minutes)
	.....	AM: 500W (10 minutes)
5. Proper input power for automatic tuning	.....	5/10/50W (3 position)
6. Time required for tuning	.....	Less than 45 sec.

#### Sundry

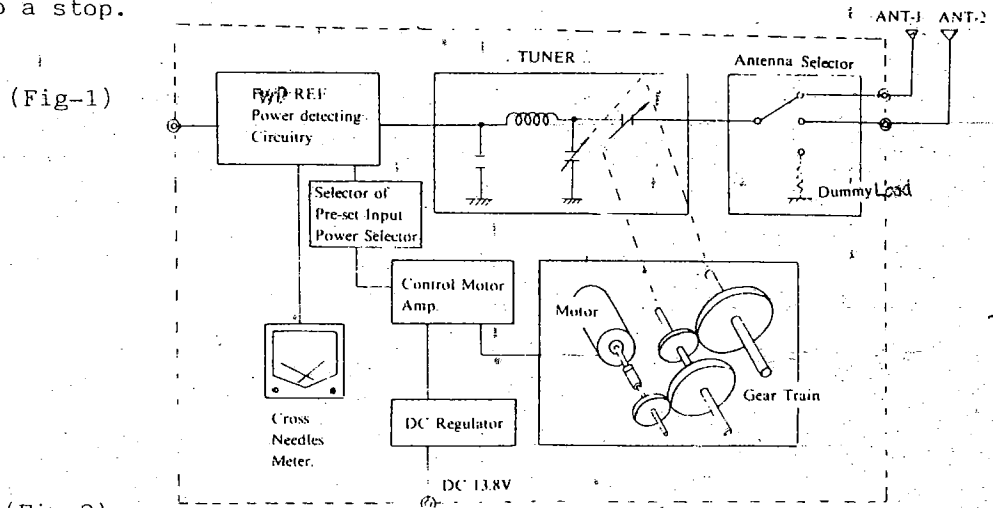
1. Input/output connector	.....	S0-259
2. Dimensions	.....	225W x 90H x 275D m/m
3. Weight	.....	4.3 kg
4. No. of output port	.....	Two
5. Dummy load	.....	100W, 1 minute rating
6. Circuit fuse	.....	0.3 A
7. Capacity of linear amplifier disable terminal	.....	DC 60V, 0.5 A
8. Power consumption	.....	13.8 V DC (11 - 16 V) 0.2 A

#### ④ OPERATION

Forward and reflected power on the antenna feedline are detected at the detecting circuit. DC voltage which is proportional to the each power is applied to the cross needle meter and the control amplifier.

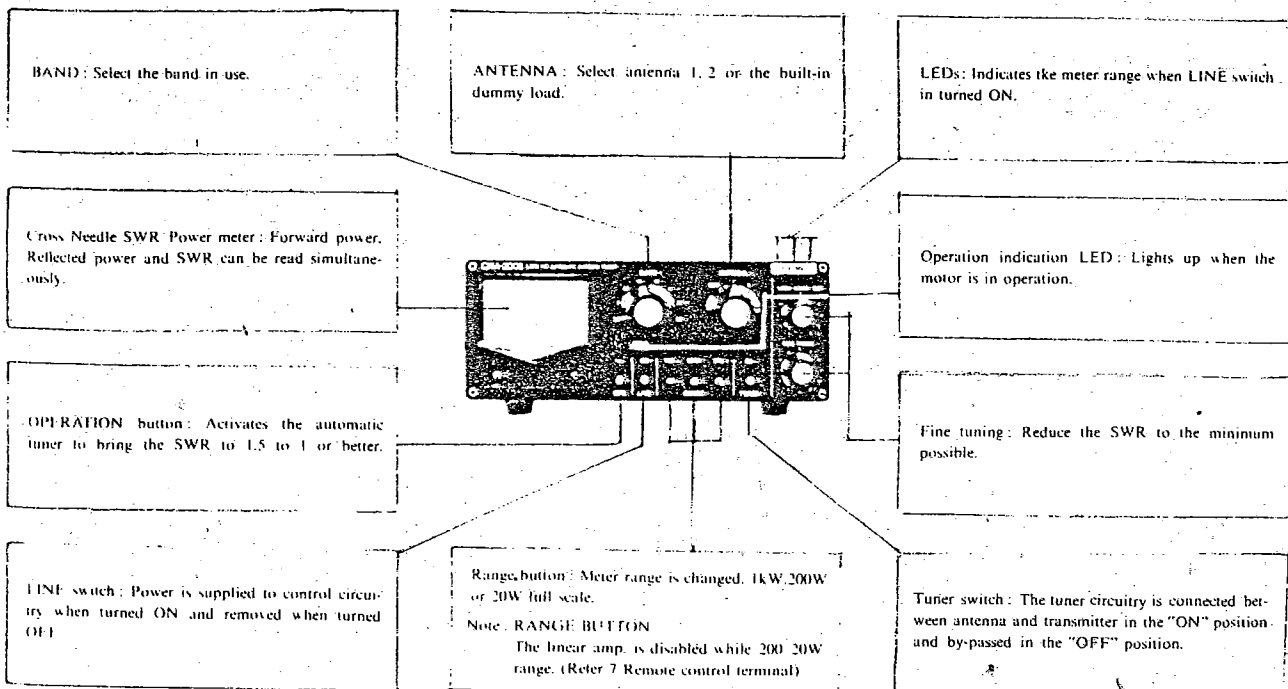
The cross needle meter displays forward, reflected and the SWR simultaneously. Each needle is driven by the forward or reflected power independently and the crossing point of two needles indicates the SWR.

DC voltage derived from the reflected power is applied to the control amplifier at the same time. It is compared with the pre-set reference voltage. The difference is processed in the control amplifier, causing the motor to turn. The motor is connected to the two variable tuning capacitors through the reduction gear train of 30:1 gear ratio. When the SWR reaches below 1.5:1, the DC voltage becomes lower than the pre-set voltage and the motor comes to a stop.



#### ⑤ CONTROLS

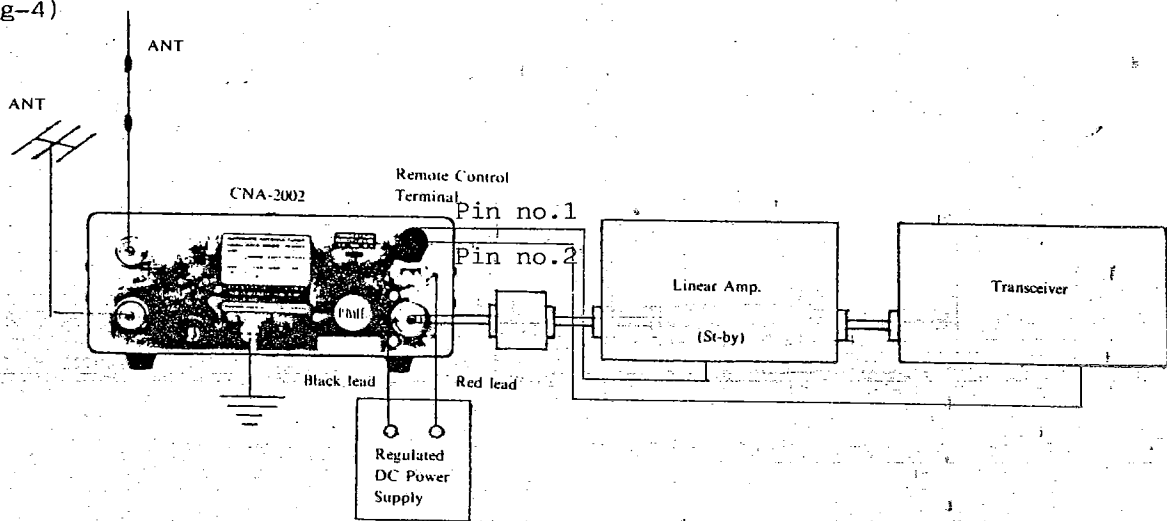
(Fig-2)



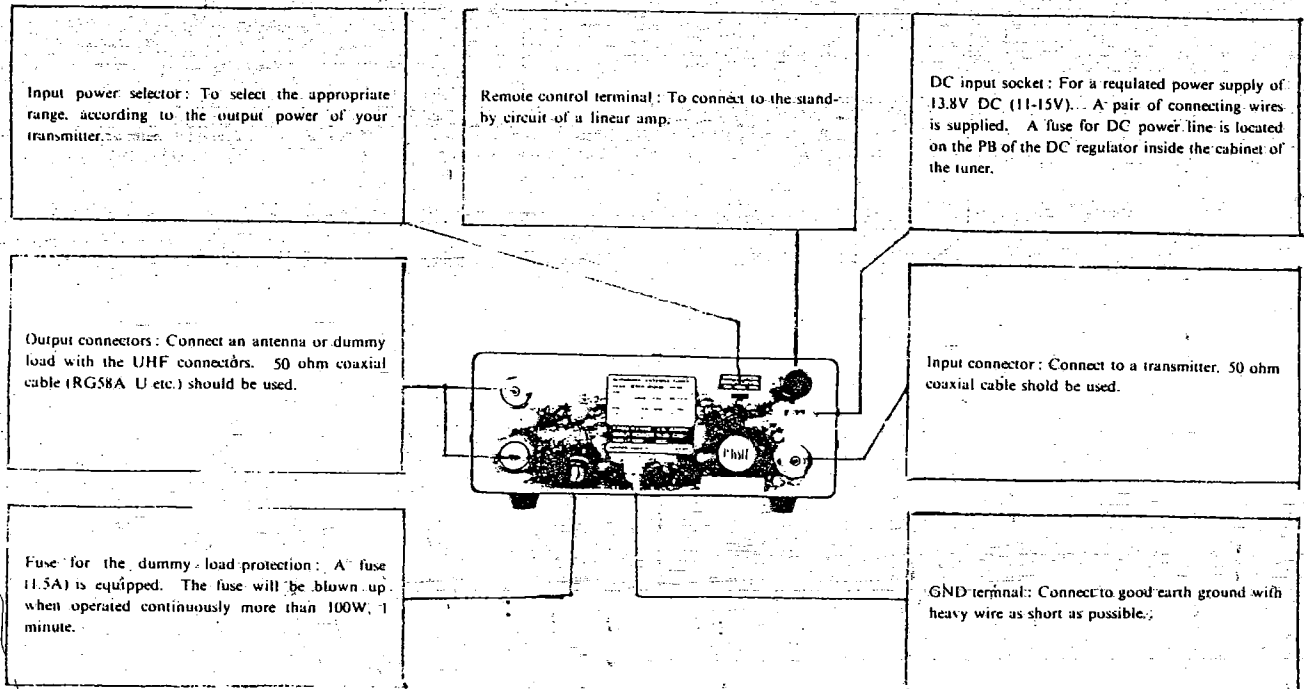
## ⑥ CONNECTION

- (1) Connect an antenna to the connectors of ANT-1 or ANT-2 on the rear panel.
  - (2) Connect the supplied black and red leads (with a plug) between the DC input socket on the rear panel and a regulated power supply (13.8V), (Red -- Positive, Black -- Negative)
  - (3) Connect your transceiver to the input connector (TR) of rear panel with 50 ohm coaxial cable.
- (\*\* Use of a lowpass filter or bandpass filter between the transceiver and the tuner is recommended for resolving TVI.)

(Fig-4)



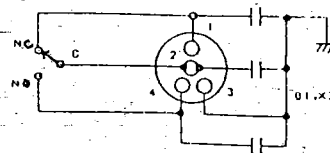
(Fig-3)



## ⑦ REMOTE CONTROL TERMINAL

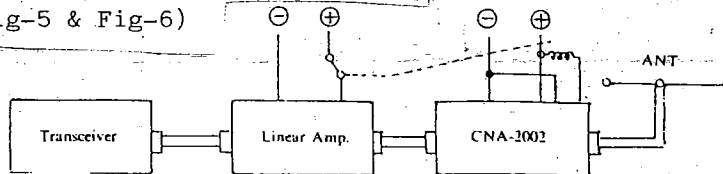
(CONNECTION)

The linear amplifier can be disabled while RANGE button is in 20/200W positions, by connecting linear stand-by control cable to the Remote Control Terminal (Refer to Fig-4, Fig-5 & Fig-6)



(Fig-6)

(Fig-5)



CONNECTION FOR A LINEAR AMP. WHICH HAS NO STAND-BY CONTROL CAPABILITY

The power relay for controlling the linear amplifier must be of 12 volt type. It must have ample capability to handle the power requirement of the linear amplifier in use.

## ⑧ NOTES FOR CONNECTIONS

1. Never attempt to use the SWR/Power meter circuitry beyond frequency range of 1.8 - 30 MHz. Insertion loss will increase at these frequencies and accuracy of the meter will be impaired.
2. Use only 50 ohms coaxial cable for connections. This will maintain the accuracy of the meter.
3. For accurate power measurement, use 50 ohm resistive dummy load.
4. Use 13.8V DC (11-15V) well regulated power supply. Please check the voltage before connection.
5. A balun should be used in feed line when using balanced type antennas.

## ⑨ NOTES BEFORE OPERATION

Please read carefully before operation.

Power rating of the CNA-2002

SSB: 2.5 kW PEP (10 minutes) (Normal speech and no processing device)

CW: 1 kW (50% duty)

SSTV, RTTY: 500W (10 minutes)

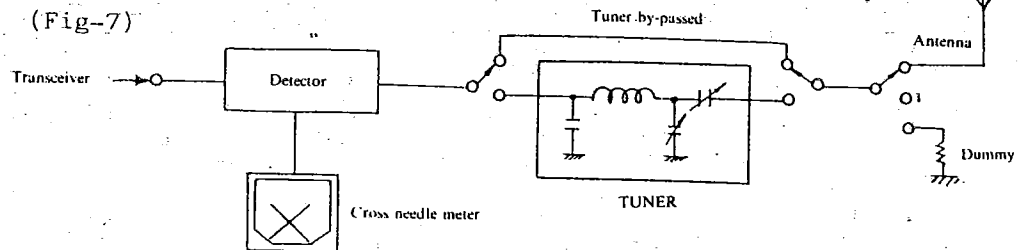
AM: 500W (10 minutes)

- (1) The above specifications are correct when the tuner is tuned to an SWR of below 1.5:1. Power rating is different on each mode and band. You should confirm power rating for your operating mode and band before operation.
- (2) Exceptionally high voltage may be generated in the CNA-2002 when a poorly matched antenna is connected to the tuner, or it is operated without connecting an antenna, components of the CNA-2002 might be damaged by the high voltage.
- (3) Do not change position of the switches; "BAND", "ANT" or "TUNER ON/OFF" with RF power on the tuner. Do not transmit when antenna is disconnected from the tuner.
- (4) Occasionally a noise may be heard in your receiver which is generated in the DC-DC converter. In such cases, turn off the CNA-2002 line switch.
- (5) The CNA-2002 does not function properly when an antenna with SWR of higher than 5:1 is used.

## ⑩ OPERATING EXPLANATION

The CNA-2002 consists of the SWR/power meter together with automatic antenna tuner circuitry. The tuner circuitry can be by-passed by pressing TUNER ON/OFF button on the front-panel, and the SWR/power meter circuitry can be used independently while the tuner is by-passed.

### 10-1 SWR/Power meter independent operation.



(1) Set the switches as follows:

LINE . . . OFF or ON. (The LEDs do not light up when LINE OFF, however the SWR/Power meter can be used regardless of LINE switch position.)

RANGE . . . 200W

TUNER . . . OFF (By-passed)

ANT . . . DUM (The built-in dummy load can be used at input power below 100W, 1 minute.)

\*\*\*\*Tune your transmitter's PA stage.

(2) ANT . . . Set to ANT-1 or ANT-2.

RANGE . . . Set to appropriate position according to the transmitter's output power.

(3) Transmit the transmitter.

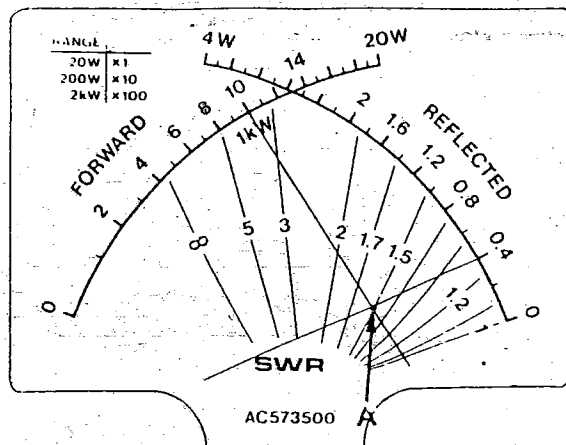
Forward power and reflected power can be read on the meter, and the SWR can be read at the crossing point of two needles simultaneously.

(4) Measurement of effective radiation power.

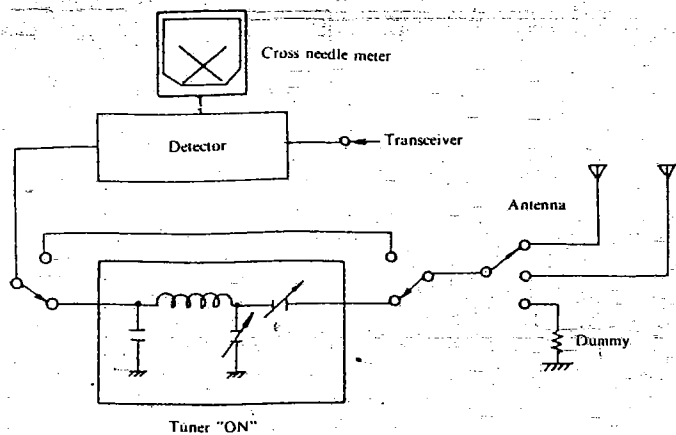
To measure effective radiated power, subtract reflected power from Forward power (cable loss is not included).

Referring to Fig-8, the meter indicates Forward power of 100 watts and Reflected power of 4 watts.  $100 - 4 = 96$  watts: The effective radiated power is 96 watts. At the crossing point of the two needles, the indication is the SWR 1.5:1.

(Fig-8)



### 10-2 Automatic tuning operation. (Fig-9)





**AUTOMATIC TUNING SHOULD BE DONE ONLY WITH  
LINEAR SWITCH "OFF" OR "ST-BY" POSITION**

- (1) Pre-set the controls as follows:  
LINE . . . ON  
RANGE . . . 200 or 20W (The LED lights on.)

**AUTOMATIC TUNING CAN BE DONE IN 200W or 20W POSITION**

- TUNER . . . OFF  
BAND . . . Set to the band in use.  
ANT . . . DUM  
FINE TUNING . . . Set to 12 o'clock position.

- (2) RANGE . . . 20/200W

- (3) Adjust the output power of the transmitter to 5, 10 or 50W by the transmitter output control.

The recommended power for automatic tuning is as follows:

Transmitter's nominal output:	Power output recommended for tuning:
100 $\Delta$ 200 watts	50 $\Delta$ 10 $\Delta$ 5 watts
50 $\Delta$ 100 watts	10 $\Delta$ 5 watts
10 watts	5 watts

Decrease the power output is a protection circuit of the transmitter is activated whilst autotuning.

The CNA-2002 can not be tuned at the positions of power range 1 kW. Automatic tuning can be done only at the 20W or 200W position. Please make sure of the position of power range before starting automatic tuning.

- (4) TX . . . ST-BY

ANT . . . DUM/ANT-1/ANT-2

Set the ANTENNA selector switch to ANT-1 or ANT-2 which is in use. Please make sure that the SWR of the antenna connected is below 5:1. The automatic antenna tuner can not tune when the SWR of an antenna is higher than 5:1.

- (5) TUNER . . . ON

Transmitter . . . ON (5, 10 or 50 watts.)

Push the OPE button.

The motor will start to rotate. The OPE indicator LED will light during motor rotation.

- (6) The motor will stop at around an SWR of 1.5:1. To lower the SWR, adjust the fine tuning knobs alternately, until the SWR decreases to 1:1.

- (7) Adjust the P.A. tuning of the transmitter for maximum power.

- (8) When the SWR rises higher than 1.5:1 when changing frequency in the same band, the SWR can be compensated by adjusting the fine tuning knobs.

Please make sure the RANGE switch is set to proper position before transmitting on-air.

NOTE Automatic tuning is only done with LINE switch:ON, Power range: 20W or 200W and TUNER: ON.

If following conditions occur, please carefully read each clause for your reference.

(1) If auto tuning stops before the SWR comes to 1.5:1 or less.

\* Input power is too low for auto tuning . . . Refer to 10-3.

\* The protection circuit of the transceiver is activated . . . Refer to 10-3.

(2) Auto-tuning has not stopped 1 minute after operation started.

\* A poor matched antenna is connected. The SWR of the antenna is higher than 5:1 . . . Please adjust the antenna's SWR to below than 5:1. (Please refer to 11-2)

\* A high level of spurious or harmonic signals are contained in the transmitted signal. . . . Use of a lowpass filter or a bandpass filter is suggested.

\* Input power for auto-tuning has exceeded the proper power . . . Refer to 10-3.

\*\*If the auto-tuning circuitry becomes faulty, you can operate it manually.

The motor in the CNA-2002 will rotate while pushing the OPE button, and the CNA-2002 can be tuned to the best SWR manually.

## 11 PRECAUTIONS AGAINST TROUBLES

11-1 Erroneous operations by RF oscillation.

(1) RF oscillation in a regulated power supply.

(2) RF oscillation at the power supply circuitry of the CNA-2002.

(3) RF oscillation by leakage current from antenna feeder.

\*Precautions for (1) and (2).

Connect by-pass capacitors on the DC line and use a line filter in the AC power line, wind the AC power cord at least 10 turns on a ferrite toroidal core ( $\mu=100$  minimum required).

\*Precautions for (3)

Use a balun in your antenna.

Wind the coaxial cable of your antenna 10 turns on a toroidal core ( $\mu=100$  minimum required).

Connect the equipment to good earth ground with heavy wire as short as possible.

11-2 When the SWR can not be reduced.

When the tuner can not tune the SWR below 1.5:1, please check the following points.

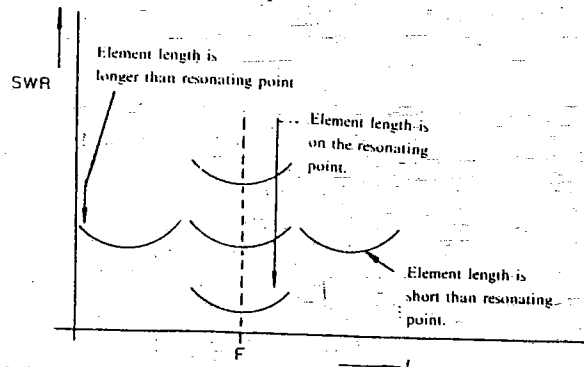
1. Spurious or harmonic signals are contained in the transmitter output, so the SWR will be not reduced.

Please check and realign your transceiver if necessary.

2. The antenna is not resonant on the band in use.

Please adjust the element length of the antenna.

(Fig-10)



(REFERENCE-1)

The power meter indication.

The power meter indicates the mean value of output power. For the measurement of power in SSB mode, a single tone signal or continuous wave is required as input for microphone amplifier. When a voice signal or two tone is applied, the indication of the output meter is 40 - 50% below that of single tone. By whistling into the microphone the meter will indicate the same power as continuous wave.

The tolerance of a meter is indicated as + \*\*% at full scale i.e. in the case of a meter tolerance of  $\pm 10\%$ , this would indicate an error of  $\pm 2W$  at full scale reading of 20W. However, this does not mean that the error is  $\pm 1W$  at 10W or  $\pm 0.1W$  at 1W on the same meter scale.

(REFERENCE-2)

SWR is calculated by following equations.

$$SWR = \frac{P_f + P_r}{P_f - P_r}$$

$P_f$ : Forward power  
 $P_r$ : Reflected power

Refer to Fig-8.

The meter indicates  $P_f:100W$   $P_r:4W$ .

$$SWR = \frac{100 + 4}{100 - 4} = \frac{104}{96} = 1.083$$

(REFERENCE-3)

SWR=1.5:1 means, the reflected power shares 4% of the output power. SWR=1.2:1 means the reflected power shares 1% of the output power. Comparing typical cable loss with the loss due to the SWR, the SWR loss can be negligible.

(REFERENCE-4)

(Fig-11)

Attenuation characteristic of the CNA-2002.

