

KENWOOD

SW-2000

SWR/POWER METER

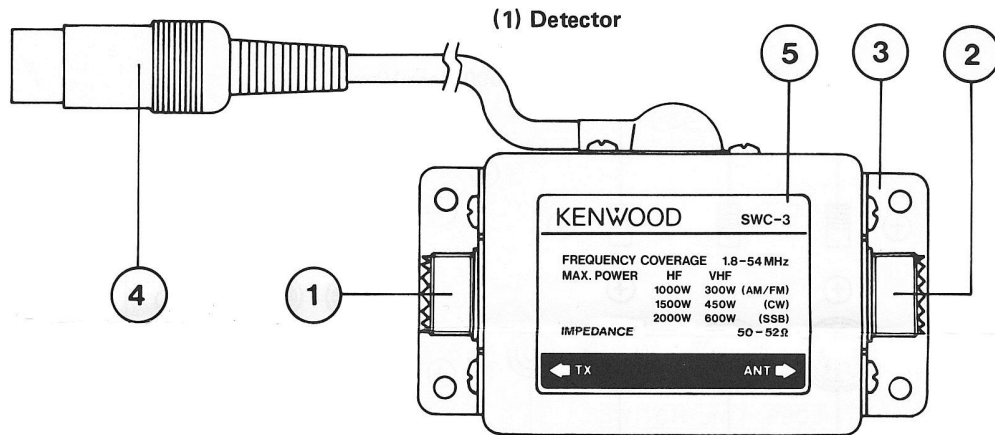
■ Features

The **SW-2000** through-type SWR/POWER meter which, in conjunction with a directional coupler, can be used in the 1.8 – 450 MHz frequency range.

- As a through-type meter, it can be connected between the transmitter and antenna so that output can be measured during operation.

■ Component parts and their functions

- ① **TX Connector**
A UHF connector accepts transmitter output through a 50Ω coaxial cable.
- ② **ANT connector**
UHF connector for the antenna or dummy load.
- ③ **Coupler bracket**
Use this to affix the coupler with screws. The coupler can be mounted on the rear of the display unit.
- ④ **Detector cable**
Connect to the coupler input terminal on the display unit rear panel.
- ⑤ **Nameplate**
This indicates the rating of the coupler. Do not attempt to use the coupler at power levels exceeding the specified rating.

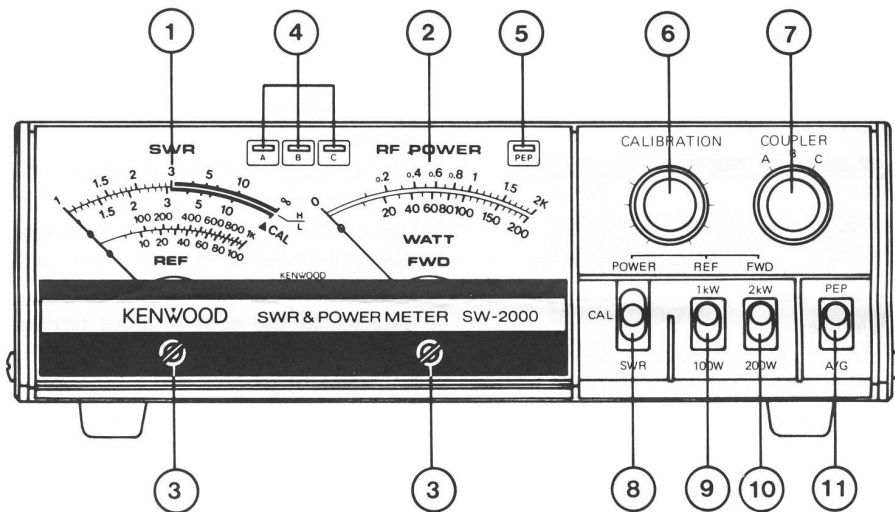


(Figure denotes SWC-3)

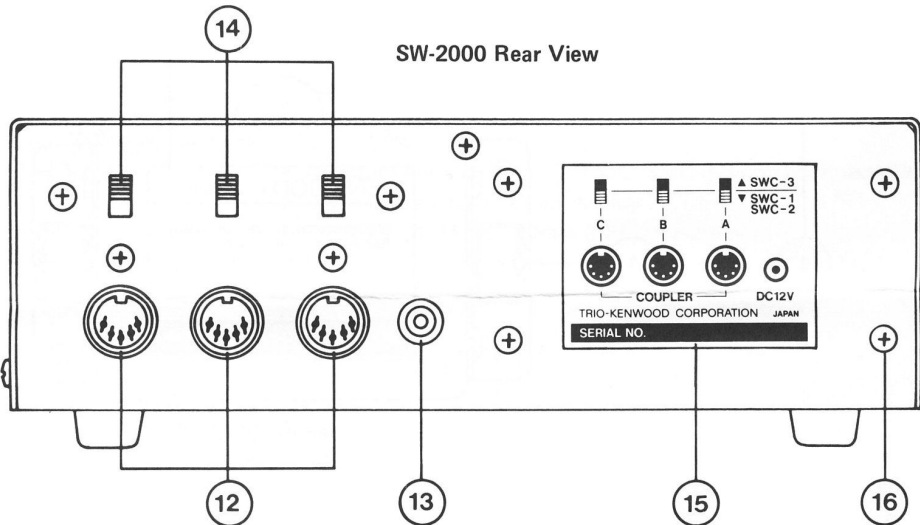
- Either a toroidal directional coupler (**SWC-1/SWC-3**) or a strip line directional coupler (**SWC-2**) are used in the companion detectors. Sensitivity is high, the output characteristics are flat and power can be measured without any calibration or calculation. SWR may be measured with as little as 30W of RF power (approx. 3W when using **SWC-1**) in the 1.8 MHz HF band.
- The coupler and display unit can be separated so the display unit can be mounted wherever convenient. Since up to 3 couplers can be connected to the display unit, one display unit can be used to observe a number of transmitters or antenna systems.
- The display unit uses dual meters to simultaneously measure forward and reflected power for fast and easy transmitter and antenna tuning.
- The **SW-2000** SWR/POWER meter can measure single side band PEP (Peak Envelope Power).

(2) Display

SW-2000 Front View



SW-2000 Rear View



- ① **REF/SWR meter**
Displays SWR and the reflected power.
- ② **FWD meter**
Displays the forward power.
- ③ **Meter zero adjustment**
Mechanical adjustment for the meter pointer 0.
- ④ **Coupler indicators**
With an RF output power of 5W or more, these indicate which coupler has been selected. In SSB, these "Flicker" with modulation.
- ⑤ **PEP mode indicator**
Lights when the PEP measuring mode is selected.
- ⑥ **Calibration control**
Used to adjust meter calibration in the SWR mode.
- ⑦ **Coupler selector**
Used to select the A, B or C coupler.
- ⑧ **Function selector**
Used to select the power or SWR measuring mode.
- ⑨ **REF power range selector**
Used to select the 100W or 1KW reflected power measuring range.
- ⑩ **FWD power range selector**
Used to select the 200W or 2KW forward power measuring range.
- ⑪ **Power measurement mode selector**
Used to select AVG or PEP measurement.
- ⑫ **Coupler input connectors**
DIN connectors accept couplers A, B and C.
- ⑬ **DC input jack**
Connect the cable to your station DC power supply for PEP measurement and to light the meters.
- ⑭ **Coupler switches**
Used to connect each coupler input connector of A, B and C to either 200W (SWC-1/SWC-2) position or 2KW (SWC-3) position.
- ⑮ **Nameplate**
- ⑯ **Coupler mounting**
One coupler can be mounted with 4 screws.

■ Before operation

- 50Ω coaxial cables are required, properly terminated with good quality UHF connectors. If an SWC-2 coupler (140 – 450 MHz) is poorly installed, it will result in measurement errors. Always use heavy coaxial cable.
- For accurate measurement, use a good quality non-inductive 50Ω dummy load with an SWR of less than 1.1.

■ Connection

Up to 3 couplers can be connected simultaneously (one is supplied as standard).

- Connect the transmitter output to the coupler TX connector and the antenna or dummy load to the ANT connector using 50Ω coaxial cable. If an antenna tuner is used, connect it between the antenna and coupler as shown above.
- Select the coupler using the coupler selector. The corresponding indicator lights when RF power is applied.
- To measure PEP or to light the meters, connect the DC input jack to a 12V DC power supply using the red/black cable provided. Connect red to (+) and black to (-). If the cable is connected with reverse polarity, the PEP circuit will not function and the FWD meter will not deflect. Do not apply a DC voltage greater than 15V.

■ Operation

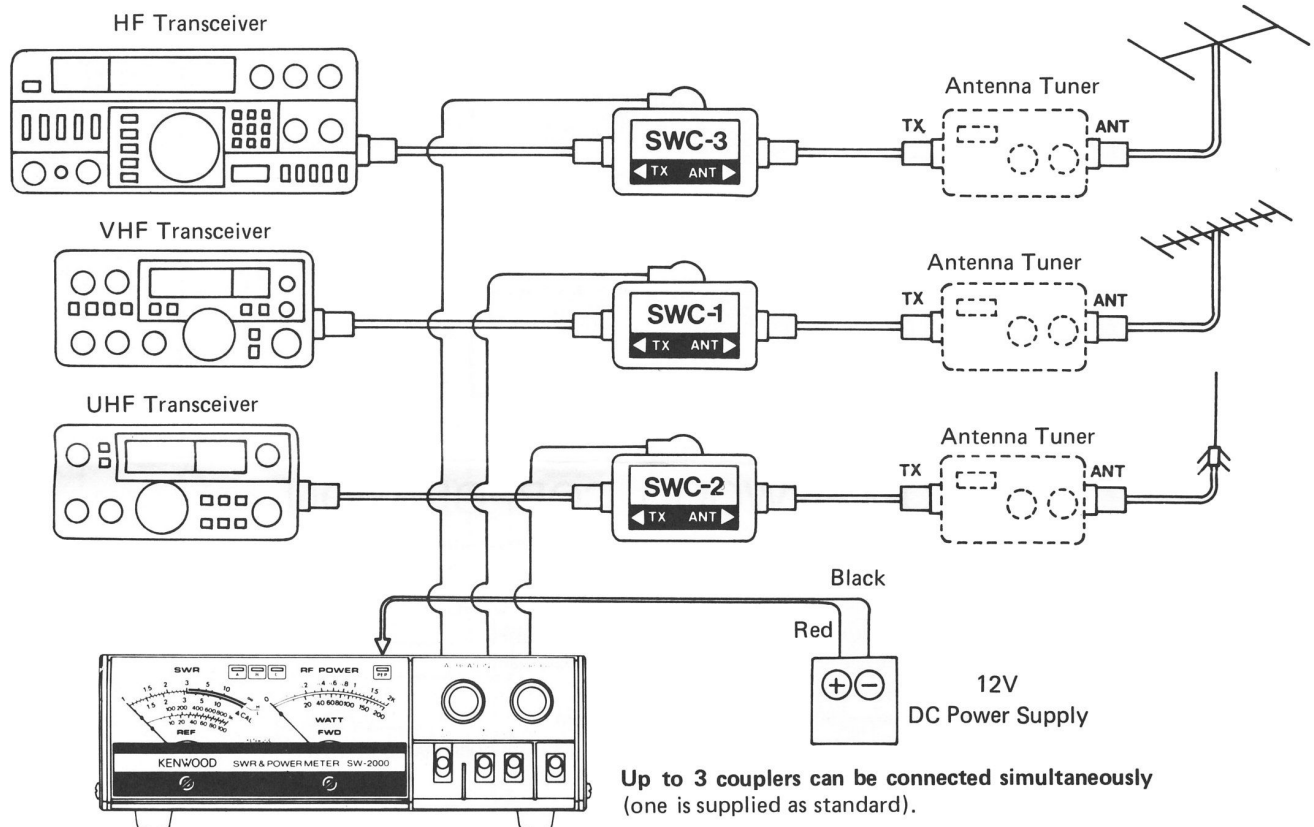
- **Remember:** The airwaves are already sufficiently crowded.
 1. Listen on frequency before transmitting.
 2. Use the least possible amount of power from the transceiver consistent with reliable measurement.

3. Keep dead-carrier transmissions as short as practical. This helps both your equipment, and fellow operators.
4. Please be courteous when testing.

- Before keying the transmitter, turn the calibration control fully counterclockwise and select the high power range to protect the meter.
- When SWC-1 and/or SWC-2 is connected, place the coupler switch in the (SWC-1/SWC-2) position (lower side), and when SWC-3 is connected, place the switch in (SWC-3), upper side. Improper setting of the switch(es) results in incorrect power reading, always make sure the position(s).

(1) Measuring forward (FWD) and reflected (REF) power.

- Set the mode selector to AVG or PEP depending on the transmitter power mode. To measure AM, FM or CW carriers, set the selector to AVG. For SSB operation, select either AVG or PEP, as required.
- Set the function selector to POEWR.
- When the transmitter is keyed, both the FWD and REF meters will deflect. Set the power selector to the appropriate range and read the power using the corresponding scale.
- The FWD meter indicates forward power applied from the transmitter to the antenna or dummy load. The REF meter indicates the power reflected from the load. Both meters function simultaneously.
- When adjusting an antenna or antenna tuner, obtain a minimum REF reading.



- When making a measurement with **SWC-1** and **SWC-2**, the full scale of the FWD meter denotes 20W/200W, and the REF meter 10W/100W. Accordingly, the actual value is one-tenth of the indicated value.
- **Power Display in the 50 MHz band**
Since the output characteristic of the coupler is degraded in the 50 MHz band as compared in the HF band, the reading value of the meter should be increased by approximately 15% to obtain the corrected value.

(2) Measuring nominal forward power.

- The nominal forward power is the difference between the forward and reflected power and is equal to the power radiated by the antenna.
Example: When the FWD reading is 500W and the REF reading is 20W, the nominal forward power is 480W.

(3) Measuring PEP power.

- Place the mode selector to PEP and the PEP indicator will light. Measure the PEP output in SSB operation just as you would measure AVG power.
- SWR/POWER in FM and AM measures the power of the unmodulated carrier. In SSB, there is no carrier and the power output changes with the voice signal. Normally, the peak power of a modulated signal is measured as PEP (Peak Envelope Power).
- The average power meter for FM and AM is calibrated using a CW carrier. In the **SW-2000**, an operational amplifier detects the voice signal peak power during transmission, and this is displayed as the PEP.
- The diagram below shows the carrier power, average power and PEP for each power waveform. In SSB operation, the peak voice signal during communication is the PEP.

RF power with each modulation type

	Carrier power	Average power	PEP
AM/FM carrier	100	100	100
AM single tone, 100% modulation	100	150	400
SSB single tone modulation	—	100	100
SSB, 2 tone modulation	—	50	100
SSB, voice signal modulation	—	20 ~ 25	100

Reproduced from the JARL Amateur Radio Handbook

(4) Measuring SWR (standing wave ratio) power.

- Set the function selector to CAL.
- Key the transmitter and adjust the calibration control clockwise to bring the SWR meter pointer to the ▲ CAL mark (full scale).
- Place the function selector to SWR and read the SWR power.

- Because detector diode output is non-linear, the actual SWR power is slightly different from the measured value. However, the value is close at low power. To eliminate this error, the SWR meter has dual scales; L for 100W and H for 1KW. At low power (up to 200W), use the L scale. At high power (more than 500W), use the H scale.
- The SWR power can be calculated from the FWD power (Pf) and REF power (Pr) using the formula:

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

SRW	Pr/Pf(%)
1.0	0
1.2	0.8
1.5	4.0
2.0	11.1
2.5	18.4
3.0	25.0

Example
Pf = 400W
Pr = 16W

$$SWR = \frac{\sqrt{400} + \sqrt{16}}{\sqrt{400} - \sqrt{16}} = \frac{20 + 4}{20 - 4} = \frac{24}{16} = 1.5$$

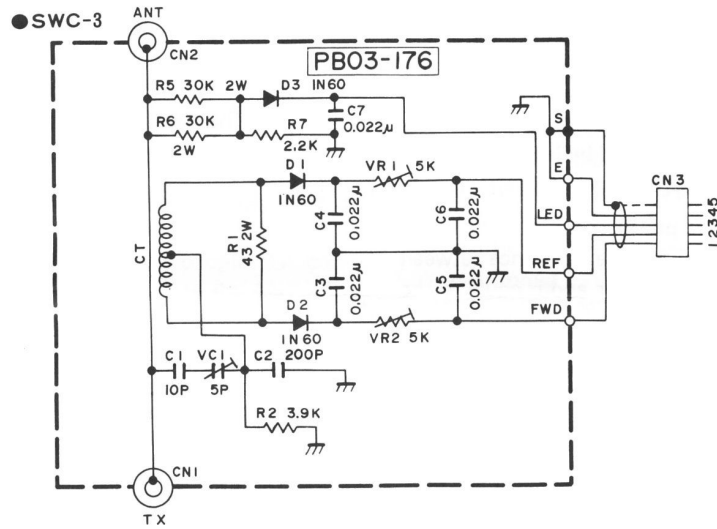
- The FWD meter does not function in the SWR measuring mode.

■ **Notes**

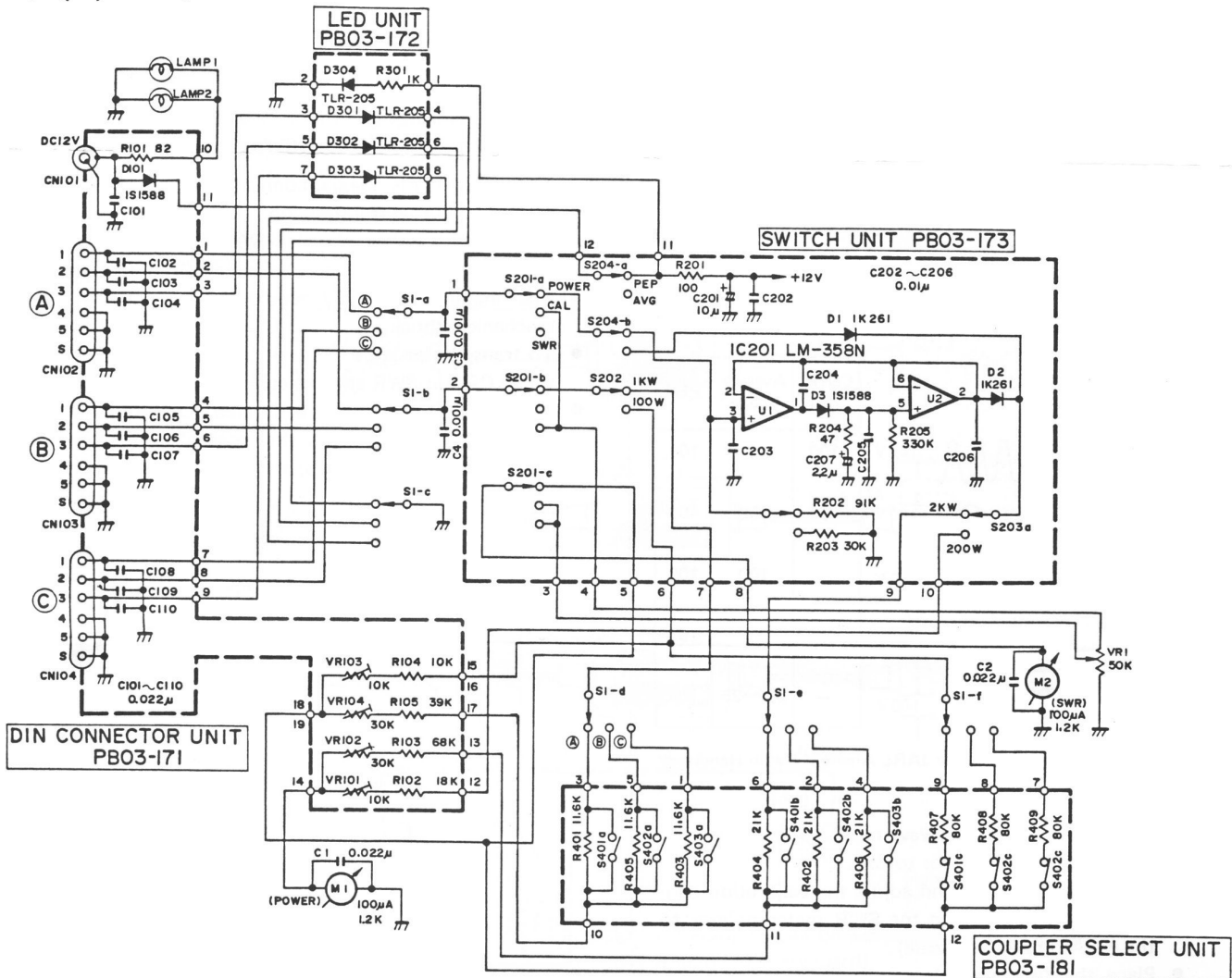
- Fully tighten the coaxial connectors and do not disconnect them during transmission.
- If used with extremely high SWR power, high voltage will be applied to the unit and can result in damage.
- The meters are highly sensitive; protect them from mechanical shock.
- To transport or store the unit, place the function selector to CAL or SWR and the calibration control to 0.
- This unit left the factory calibrated. Do not remove the case or otherwise touch the internal components, as this can result in measuring error or other malfunctions.

SCHEMATIC DIAGRAM

(Coupler Section)



(Display Section)



Specifications are subject to change without notice.

■ Specifications

(1) Coupler section

Item	SWC-3 (attached to SW-2000)	SWC-1 (option)	SWC-2 (option)
Impedance	50 – 52Ω	50 – 52Ω	50 – 52Ω
Frequency range	1.8 – 54 MHz	1.8 – 150 MHz	140 – 450 MHz
Feed through power overload	HF VHF 1000W 300W 1500W 450W 2000W 600W	200W 300W 400W	100W (AM/FM) 150W (CW) 200W (PEP)
Insertion loss	Less than 0.3 dB	Less than 0.3 dB	Less than 0.5 dB
Residual SWR	Within 1.2	Within 1.2	Within 1.2
Connector	M type (SO-239)	M type (SO-239)	M type (SO-239)
Detector cable length	Approx. 1.5m	Approx. 1.5m	Approx. 1.5m
Dimensions	68(W) x 32(H) x 50(D) mm () including projecting parts (93) (33) (62)		
Weight	260g.	260g.	260g.

(2) Display section

Power measurement range	Progressive wave power (FWD): 0 – 200W, 2KW 2 ranges Reflected wave power (REF): 0 – 100W, 1KW 2 ranges
Power measurement accuracy	1.8 – 30 MHz ±10% (Full scale) 50 – 54 MHz –15%
Power measurement mode	AVG, PEP 2 modes
SWR measurement range	1 : 1 – 1 : 10
Minimum power for SWR measurement	Approx. 30W
Coupler connection and display	<ul style="list-style-type: none"> ● Arbitrary coupler SWC-1, SWC-2, SWC-3 3 units connectable ● 3-couplers switchable and display
Power consumption	11V – 15V DC MAX 100mA (PEP measurement and meter lamp only)
Dimensions	196(W) x 63(H) x 78(D) mm () including projecting parts (200) (70) (92)
Weight	650g.
Accessories	Red/black DC power cable, 1m length

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KENWOOD

SWC-1, SWC-2, SWC-3

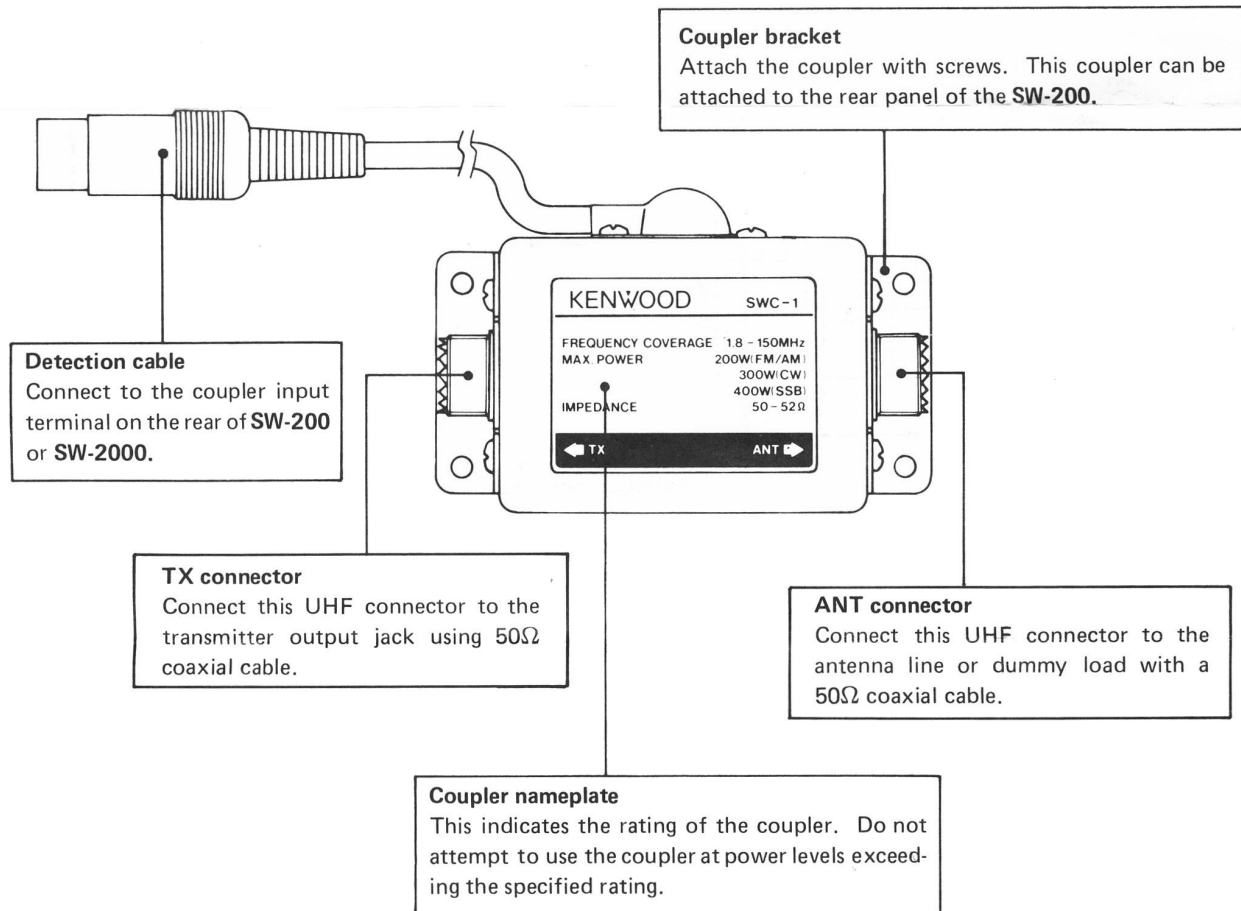
DIRECTIONAL COUPLER

■ Outline

- The **SW-200** and **SW-2000** are detector assemblies (directional couplers) for use in conjunction with **SWR/POWER** meters.
- Since both toroidal directional coupler (**SWC-1, SWC-3**) and a strip-line directional couplers (**SWC-2**) are available, high sensitivity and flat output are assured. When a directional coupler is connected to either the Model **SW-200** or **SW-2000**, the power and SWR can be read without any calibration or calculation.
- When the **SWC-1** or **SWC-2** is connected to the **SW-200**, the SWR and POWER up to 200W at 1.8 MHz – 450 MHz can be measured from 3 antenna systems. When an **SWC-3** is connected to an **SW-2000**, SWR and POWER up to 2000W can be measured from 3 antenna systems.

■ Names and Functions of the components and connections

- Connect the TX terminal (UHF connector) to the output jack of the transmitter and the ANT terminal (UHF connector) to the antenna or dummy load with a 50Ω coaxial cable. When a antenna tuner is used, connect it between the coupler and antenna. Always use 50Ω coaxial cable and terminate it with high quality UHF-type connectors. Especially when using the **SWC-2** (140 – 450 MHz), a poor connection will result in gross measuring errors. Always use heavy, quality coaxial cable.
- Connect the detection output cable to the coupler input terminal at the rear of the **SW-200**.
- For operation, refer to the **SW-200** Instruction Manual.

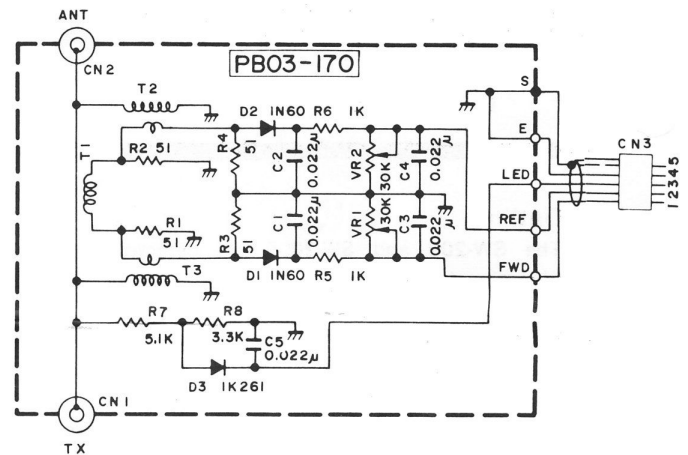


Specifications

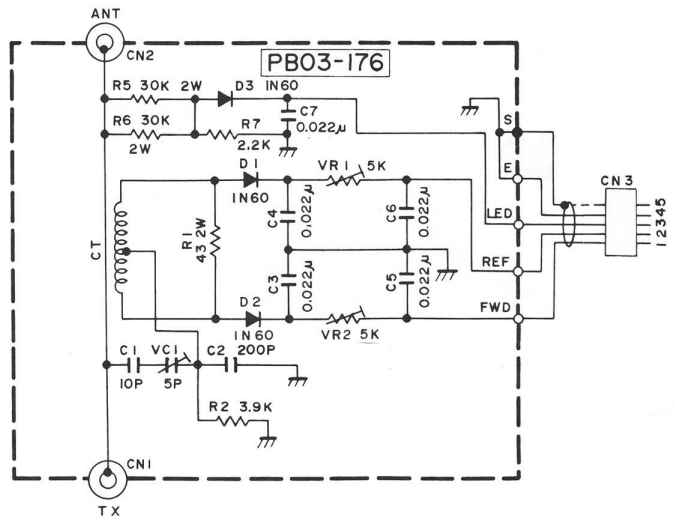
Item	SWC-1	SWC-2	SWC-3
Impedance	50 – 52Ω	50 – 52Ω	50 – 52Ω
Frequency range	1.8 – 150 MHz	140 – 450 MHz	1.8 – 54 MHz
Feed through power overload	(AM/FM) 200W (CW) 300W (PEP) 400W	100W 150W 200W	HF VHF 1000W 300W 1500W 450W 2000W 600W
Insertion loss	Less than 0.3dB	Less than 0.5dB	Less than 0.3dB
Residual SWR	Within 1.2	Within 1.2	Within 1.2
Connector	M type (SO-239)	M type (SO-239)	M type (SO-239)
Detection cable length	Approx. 1.5m	Approx. 1.5m	Approx. 1.5m
Dimensions () including projecting part	60(W) x 32(H) x 50(D) mm (92) (33) (62)		
Weight	260 g.		

Schematic Diagram

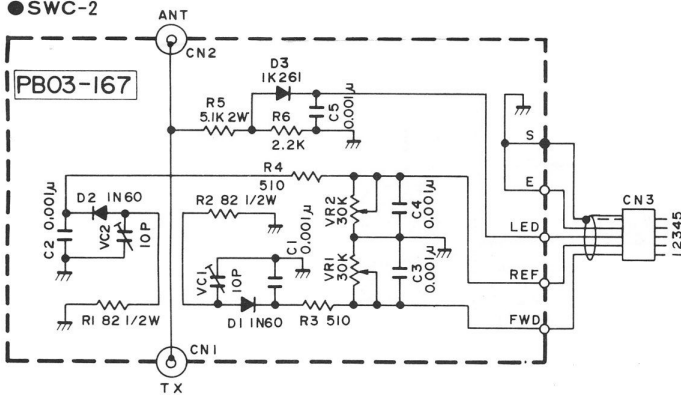
SWC-1



SWC-3



SWC-2



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