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# INFORMATION REPORT

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CENTRAL INTELLIGENCE AGENCY



50X1-HUM

COUNTRY: Hungary

SUBJECT: Examination of Hungarian "Orion" Microwave Wattmeter Type 1382/B

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SUPPLEMENT TO REPORT #

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THIS IS UNEVALUATED INFORMATION

1. MCN 14688 is a self-balancing thermistor bridge useful primarily as a laboratory instrument for measuring low output of microwave power, but also useable for measuring the attenuation of microwave coupling and attenuating devices as well as for measurements on transmitters, antennae, and feed lines.

   a. The self-balancing bridge is of a known type described, for instance, in <u>Microwave Measurements</u> by Ginzton, McGraw Hill 1957, pp. 175-76. The gain of the amplifier, used to balance the bridge, is approximately 1000 which means that the resistance of the sensing thermistor will be about one ohm greater than that of the other bridge arms (170 ohms) when the circuit reaches equilibrium.

   b. A second thermistor bridge is coupled to the output of the bridge feedback amplifier; thus, a signal proportional to the amplitude of oscillations required to balance the first bridge is supplied to the input of the second (metering and temperature compensation) bridge. With no r.f. applied, the metering bridge is adjusted for zero output as indicated by the vacuum tube voltmeter. This null is achieved by adjusting a tapped resistance (coarse and fine balance) in the arm of the bridge opposite the thermistor. If a null cannot be achieved by this method, the power supplied to the sensing bridge can be varied by means of a resistor (R) in series with the output of the feedback amplifier.

   c. Once the bridge has been zeroed, it can be calibrated on a given range by means of the built-in calibration circuit. A known value of current (adjusted to the correct value by means of the "Cal. Cur. Adj." control) is caused to flow through the r.f. sensing bridge. Calibration is independent of long-term changes in supply voltage, tube parameters, and temperature changes because the calibration current can be measured and adjusted to the correct value before each measurement. The oscillator level changes, causing the metering bridge to become unbalanced by a known amount (which should cause full-scale deflection of the vacuum tube voltmeter on the given range). The voltmeter is adjusted to show full-scale deflection by means of the "Gain" control in the vacuum tube voltmeter circuit. The meter is then ready to operate, since r.f. power applied to the sensing bolometer should cause the same unbalance in the metering circuit as the equivalent d.c. power (neglecting substitution error).

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d. The power supply is of the conventional, regulated variety with a feedback amplifier and a gas diode reference.

e. By selection of appropriate radio-frequency measuring heads, the power meter may be used in wide ranges of frequencies and power levels. Because no measuring head was obtained with the instrument, it was necessary to improvise a measuring head of about ± 5 percent accuracy using an x-band bolometer mount tuned for minimum reflections at 9,000 m.c. when the enclosed Sperry 550 thermistor was biased to 170 ohms resistance. A second Sperry 550 thermistor was fixed outside the bolometer mount to provide the temperature compensation.

2. Conclusions advanced by the examing authority include the following:

a. MCN 14688 is suitable for laboratory and production applications that require radio-frequency power measurements of moderate accuractcy within the power range of the instrument, at frequencies from 0 to 10,000 megacycles provided a well-designed measuring head is used.

b. No significant improvement over similar instruments of USA manufacture was noted.

(1) The temperature-compensation feature is advanced.

3. MCN 14688 was compared with the U.S. Hewlett Packard Model 430C and the Polytechnic Research & Development Company Model 630A powermeters. Each of these instruments uses a self-balancing bridge for the purpose of re-establishing bridge balance when r.f. power is applied, and they all use a calibrated vacuum tube voltmeter connected to some point in the bridge circuit to measure a change in signal level which can be interpreted as indicating r.f. power level. All three meters have similar accuracy when used with the appropriate r.f. measuring head. Here the similarity ceases.

a. Neither the Hewlett Packard nor the PRD powermeters use temperature compensation. One U.S. model powermeter, which is in the designing stage uses a temperature compensating thermistor, which is enclosed in the case of the powermeter rather than in the r.f. measuring head. The temperature compensating resistor in MCN 14688 is enclosed within the r.f. measuring head where it will do the most good.

b. In both the Hewlett Packard and PRD meters the input to the vacuum tube voltmeter is connected across the same bridge to which the r.f. sensing element is attached. Therefore, in order to obtain zero signal output when no r.f. power is applied, some d.c. bias must be used. No d.c. bias is necessary in MCN 14688 because the meter circuit is placed across a separate thermistor bridge which can be balanced by varying the signal level and the opposite arms of the bridge.

c. Probably the major weakness of MCN 14688 is its lack of flexibility with respect to the type of bolometer elements which may be used with it. Both U.S. instruments may be used with either thermistors or barreters at a fairly wide selection of bias resistances. MCN 14688 is restricted to thermistor operated at a bias resistance of 170 ohms. With certain modifications, it is believed the instrument could be made more flexible with respect to type and bias current of bolometer.

d. The power range of all of the instruments is similar, with MCN 14688 having a lower maximum power reading as well as a lower minimum full-scale reading.

e. The gain of the feedback amplifier in MCN 14688 is somewhat greater than in the U.S. power meters; but, it is doubtful that this contributes appreciably to the over-all accuracy of the instrument.

f. A tabular comparison of the three meters follows:

Comparison of Microwave Powermeters

| Characteristic | Instruments: Polytechnic Res.&Dev. Model 630A | Hewlett Packard Model 430C | Orion-EMB Type 1382/B |
|---|---|---|---|
| Type | Self-balancing bridge | Self-balancing bridge | Self-balancing bridge |
| Temperature Compensation | No | No | Yes |
| DC Zero | Yes | Yes | No |
| Amplifier Gain | Up to 300 | ? | 1,000 |
| Meter across bridge input | | X | |
| Meter across bridge output | X | | X |
| Vacuum tube voltmeter | X | X | X |
| Bolometer type | T,B* | T,B* | T* |
| Bolometer resistance | 50;100,150, 200,250 | 100,200 | 170 |
| Power range | 0.1-100 mw full scale | 0.1-10 mw full scale | 0.03-5mw full scale |

*T = Thermistor
B = Barreter

Fig 2. BLOCK DIAGRAM

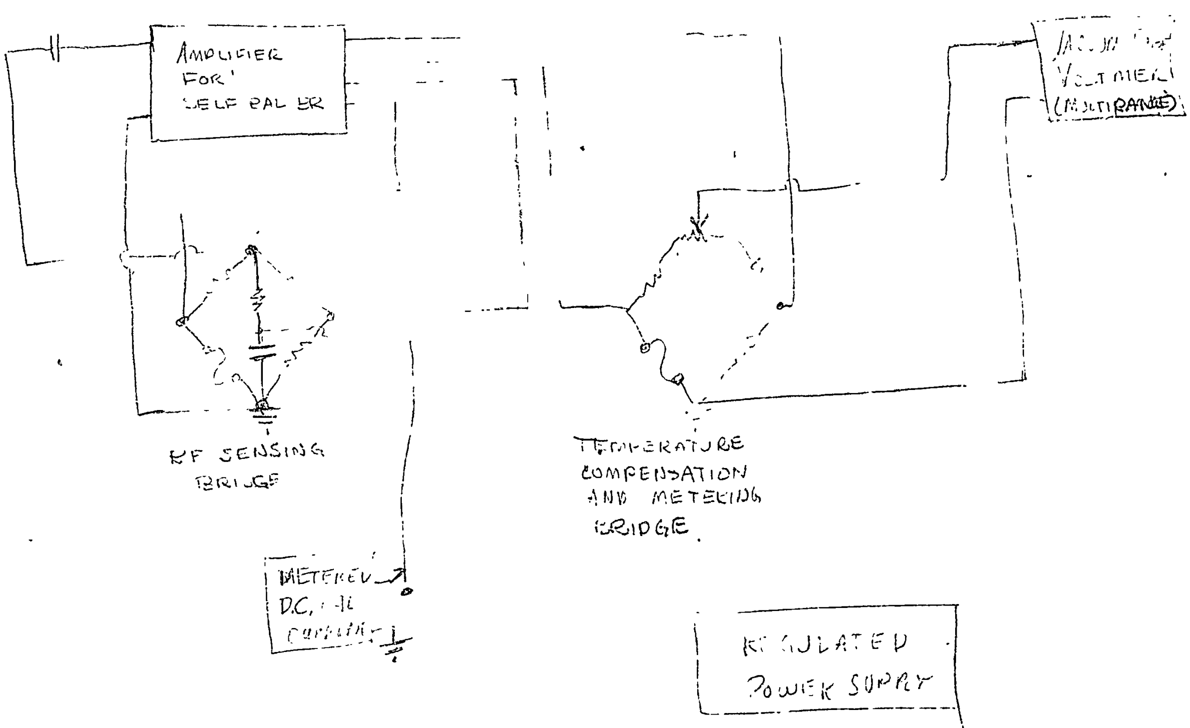

Figure 1

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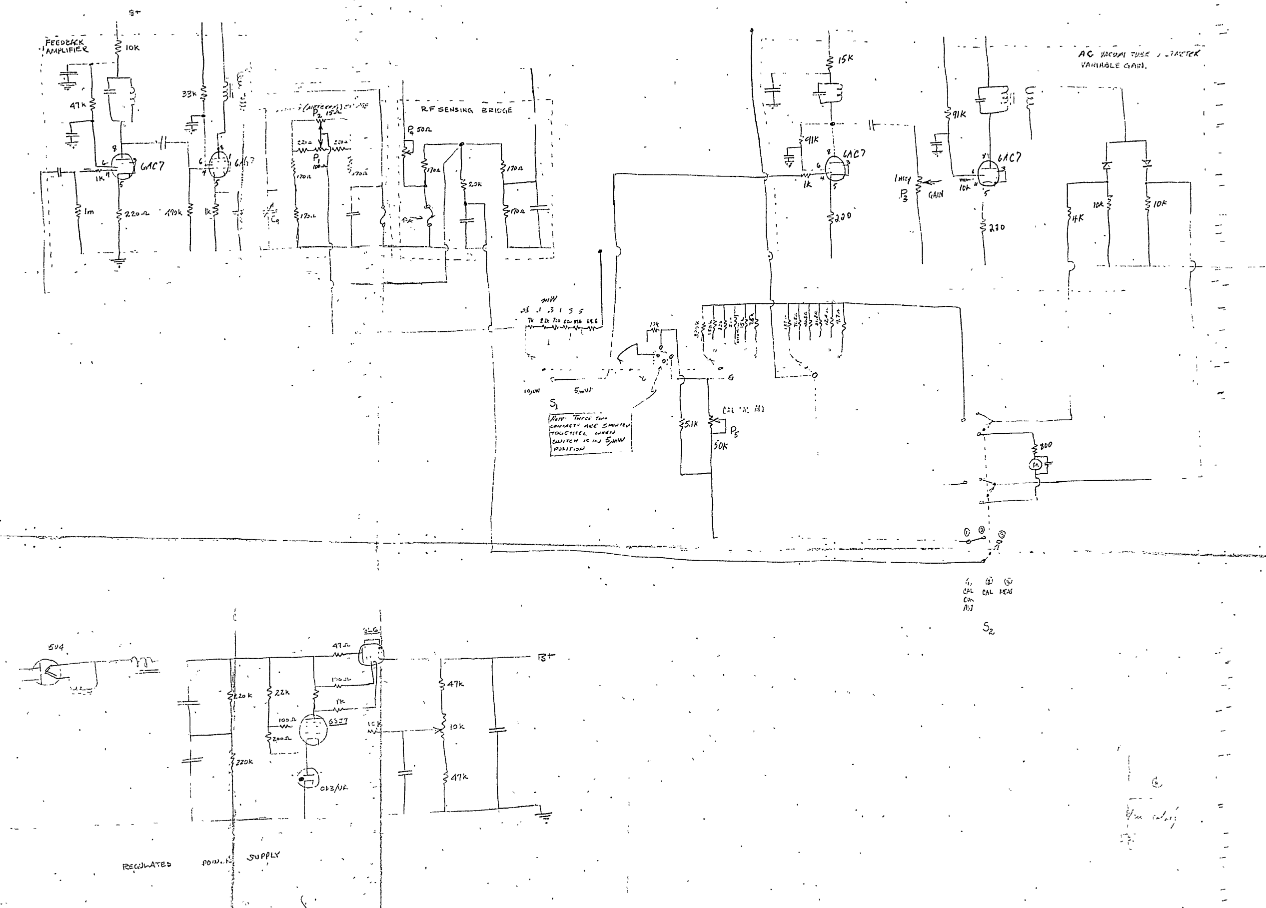


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Figure 1

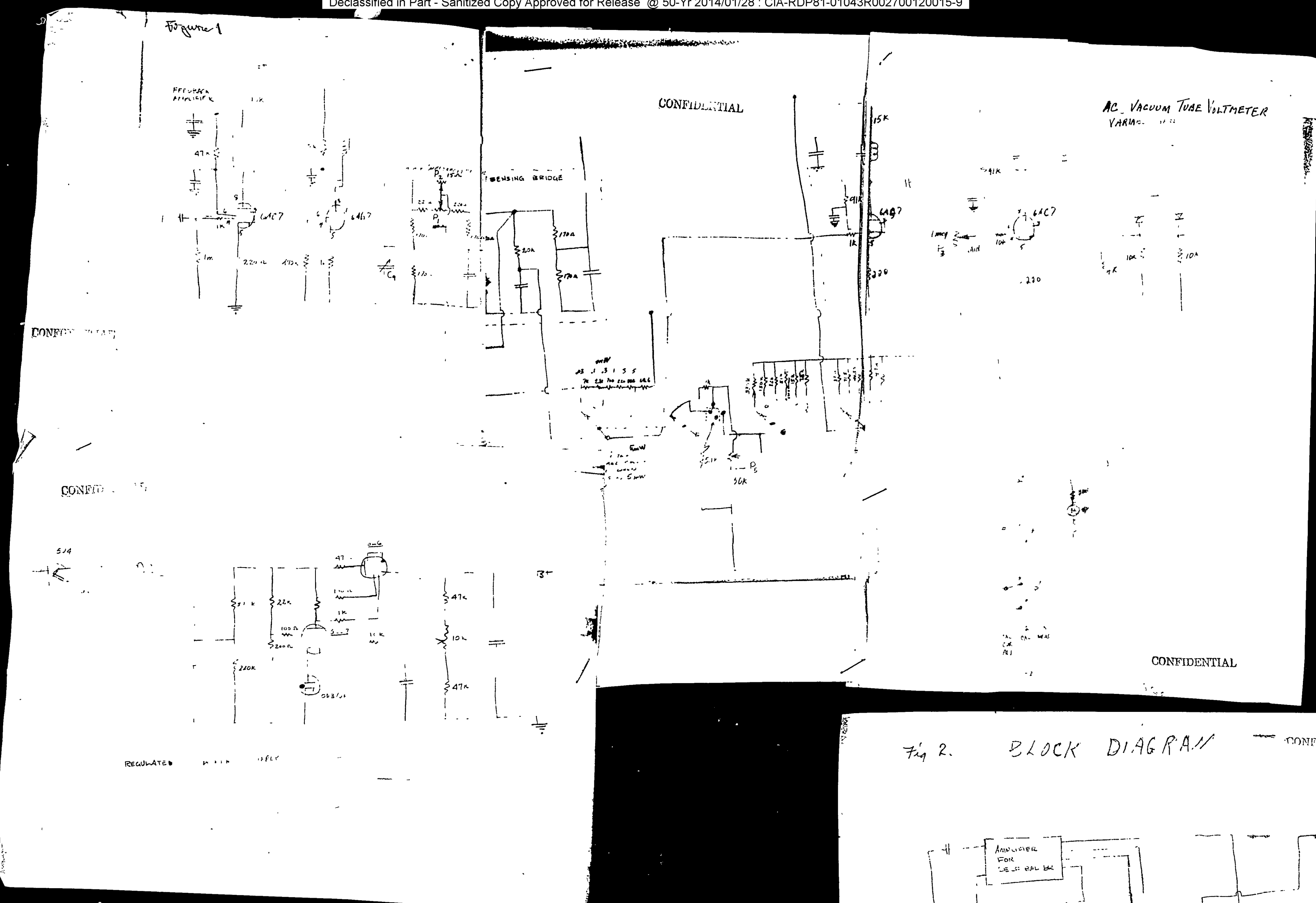
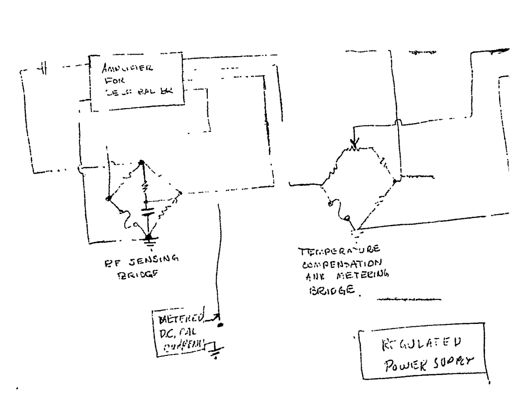



Fig 2. BLOCK DIAGRAM

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