TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR MICROWATTMETER, BOONTON MODEL 41BD WITH POWER DETECTOR 41-4E (NSN 6625-01-050-8800)

HEADQUARTERS, DEPARTMENT OF THE ARMY

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HEADQUARTERS
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REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Form 20282 in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL MA-Q, Fort Monmouth, New Jersey 07703.

In either case a reply will be furnished direct to you.

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CHAPTER 0

INTRODUCTION

0.1. Scope

This manual describes Microwattmeter, Boonton Model 42BD with Power Detector 41-4E and provides instructions for operation and maintenance. The manual includes a Components of End Item List (COEIL) (App B), and Maintenance Allocation Chart (MAC) (App D). Repair Parts and Special Tools Lists (RPSTL's) are included in TM 11-6625-2857-24P.

0.2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional pub lications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

0.3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A and DIAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as pre scribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

0.4. Reporting Equipment Improvement Recommendations (EIR)

EIR's will be prepared using DA Form 2407, Maintenance Request. Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed direct to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Mon mouth, NJ 0773. A reply will be furnished direct to you.

0.5. Administrative Storage

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-1.

0.6. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

CHAPTER I
GENERAL INFORMATION

1.1. GENERAL

The Model 42BD provides accurate, sensitive, and stable measurement facilities for rf power from the low radio frequencies to the microwave region (200 kHz to 18 GHz). The power range of this instrument covers from one nanowatt to ten milliwatts.

The Model 42BD is a solid-state, programmable instrument of high sensitivity, and low noise. Because it does not depend upon thermal sensing devices, it exhibits a very high degree of stability and ease of adjustment. This stability is of particular importance because of the resolution of the 3-1/2 digit LED display and BCD outputs. In addition to BCD outputs, a dc voltage proportional to the input power is available at a rear-panel connector. These features allow the instrument to drive recorders, remote indicators, or similar analog devices. Logic-level programming using standard TTL logic permits easy integration with complete test systems.

The 42BD is useful for making a wide variety of measurements. Representative uses of this versatile instrument include:

Adjustment of low-power transmitters, signal generators, and oscillators.
VSWR and return-loss measurements with directional couplers and slotted lines.
Gain measurements on traveling-wave tubes.
Measurements of vswr and attenuation of rf attenuators.
Antenna adjustments.

The standard features of the instrument include:
Logic-level programmability, DTL/TTL compatible.
Calibration-factor control.

BCD outputs.
DC analog output.
Low vswr.
Convenient push-button ranging.
Overload protection to 300 milliwatts.
Measurement range from one nanowatt to ten milliwatts.
Auxiliary analog panel meter for easy peaking or nulling.

The optional features of the instrument include:
dBm option with full 4 digit display and a constant 0.01 dB resolution.
Autoranging option.
Serial to parallel data output converter.

The basic characteristics of the 42BD include high reliability, high stability, fast warm-up, plug-in printed-circuit board construction for ease of servicing or modification, light weight, and other advantages of the solid-state design.

1.2. EQUIPMENT DESCRIPTION

The Model 42BD RF Microwattmeter, unlike other instruments of its kind, determines rf power by measuring the voltage appearing across a precision noninductive resistor in the Power Detector head. The panel indicator, of course, is calibrated in terms of power according to the relationship P = E /R. This detection system has important performance advantages over conventional power meters using bolometer or thermocouple detection. Sensitivity of 1 nW (-60 dBm) is orders of magnitude better; temperature stability of better than 0.01 dB/ C supports this sensitivity; and a burnout level above 300 mW reduces the most common cause of detector failure.

This instrument is available with a number of options and Power Detectors, listed in Chapter 2: SPECIFICATIONS. For all options, input-range programming can be controlled by TTL logic or PNP transistors to ground.

The Model 42BD is packaged as a compact bench instrument, with a combination carrying handle and adjustable-angle mounting foot. Should rack mounting be preferred, hardware kits to accommodate either one or two instruments are available. For the operator's convenience, essential accuracy and vswr information is reproduced on a reference plate attached to the outside top cover of the instrument. Brief calibration instructions are reproduced on the underside of the top cover.

The Model 42BD is normally ordered with one of the following Power Detectors:

Model 41-4A	0.2 MHz to 7 GHz
Model 41-4B	0.2 MHz to 12.4 GHz
Model 41-4C	0.2 MHz to 1 GHz (75 A)
Model 41-4E	0.2 MHz to 18 GHz

1.2.1. Frequency Range

The calibrated frequency range extends from 0.2 MHz to 18 GHz, depending upon the particular Power Detector used. Useful response for relative measurements can be obtained from 20 kHz to approximately 20 GHz.

1.2.2. Power Range

With any of the Power Detectors, the Model 42BD will measure power from one nanowatt up to ten milliwatts. Temporary overloads up to 300 milliwatts will do no permanent harm to the instrument or the Power Detector. When measuring pulsed signals, the accuracy is good up to 35 microwatts peak power. The power capabilities of the 42BD can be increased by the use of external attenuators.

1.2.3. Response

At low power levels the detector diodes operate in the square-law region; the instrument response is to the true average power of CW, AM, FM, and pulsed signals. Above the level of approximately twenty microwatts, response gradually becomes average, then peak, becoming peak-to-peak at approximately 0 dBm.
Although the panel meter is calibrated in terms of average power, the instrument will correctly indicate the true average power of CW and FM signals.

1.2.4. Noise

The Model 42BD has been designed and constructed to hold noise from all sources to a minimum. The Power Detector cable is of special low-noise design; a vigorous flexing causes only momentary, minor deflection on the most sensitive range of the instrument. The Power Detector is not sensitive to shock or vibration; even sharp tapping on the Detector barrel causes no visible deflection on any range.

Amplification takes place at 94 Hz, reducing susceptibility to 50 or 60 Hz fields. A unique circuit reduces the low-level noise originating in the mechanical chopper and renders the instrument immune to changes in chopper performance that could occur with the passage of time.

1.2.5. Zero Adjustment

Zero adjustment is normally not required on the upper ranges of the Model 42BD. For measurement on the lower ranges, the ZERO control is set on the most sensitive range before using. This control balances out small thermal voltages in the sensing elements and, once adjusted, requires only infrequent checking during the course of subsequent measurements.

1.2.6. Calibration Factor Adjustment

A panel-mounted control allows the sensitivity of the instrument to be adjusted in 0.1 dB steps to correct for the frequency response and mismatch errors of the detector. Calibration is in the form of indicated power to incident power.

1.2.7. Analog Output

The Model 42BD provides a dc output voltage proportional to the power being measured. The current capability of 1 mA into 1000 ohms is extremely stable. When used as part of an automatic test system, the fast response of the instrument's dc output to an input step function allows more tests per unit time.

1.2.8. BCD Output

The Model 42BD provides a binary-coded-decimal output (4-line, 8, 4, 2, 1) for connection to an external system. When it is so used, it may be remotely controlled and triggered manually or automatically in synchronism with some system event.

For system or external requirements, all input and output connections are made at the card-edge connector at the rear of the instrument case. See Figure 13 and Chapter 6 for receptacle identification and signal characteristics.

CHAPTER II
SPECIFICATIONS

Power Range:
One nW (-60 dBm) to 10 mW (+10 dBm) in seven decade ranges.

Full-Scale Power Ranges:
10 nW, 100 nW, 1 pW, 10 pW, 100 nW, 1 mW, 10 mW.

Full-Scale dBm Ranges:
-50, -40, -30, -20, -10, 0, +10.

Frequency Ranges:
0.2 MHz to 18 GHz with 41-4E Detector.
0.2 MHz to 12.4 GHz with 41-4B Detector.
0.2 MHz to 7 GHz with 41-4A Detector.
0.2 MHz to 1 GHz with 41-4C Detector (750).

Accuracy:*
10 nW to 10 mW
(-50 to +10 dBm)

+ One digit, plus			
+0.2 dB	+0.3 dB	+0.4 dB	±0.6 dB

With 41-4E:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	18 GHz
With 41-4B:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	
With 41-4A:	0.2 MHz	4 GHz	7.0 GHz		
With 41-4C:	0.2 MHz	1 GHz			

1 nW to 10 nW
(-60 to -50 dBm)

±One digit, plus			
+0.4 dB	+0.5 dB	+0.6 dB	±0.8 dB

With 41-4E:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	18 GHz
With 41-4B:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	
With 41-4A:	0.2 MHz	4 GHz	7.0 GHz		
With 41-4C:	0.2 MHz	1 GHz			

dBm (if option -09
is specified):
-50 to +10 dBm
(10 nW to 10 mW

	+0.2 dB, plus				
	±0.2 dB	±0.3 dB	+0.4 dB	+0.6 dB	
With 41-4E:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	18 GHz
With 41-4B:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	
With 41-4A:	0.2 MHz	4 GHz	7.0 GHz		
With 41-4C:	0.2 MHz	1 GHz			

-60 to -50 dBm
(1 nW to 10 nW)

	+0.2 dB, plus				
	+0.4 dB	±0.5 dB	+0.6 dB	+0.8 dB	
With 41-4E:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	18 GHz
With 41-4B:	0.2 MHz	4 GHz	8.2 GHz	12.4 GHz	
With 41-4A:	0.2 MHz	4 GHz	7.0 GHz		
With 41-4C:	0.2 MHz	1 GHz			

*On the 10 mW (+10 dBm) fs range only, add +(0.05 x reading in mW) dB to the accuracy statement for frequencies above 4 GHz.

Temperature: In accordance with ANSI (ASA) Spec. 39.7.

Temperature Range	Influence	
	Model 42BD	Detector
Ref. 210 C - 250 C	0	0
Normal, 180 C - 300 C	0	±0.1 dB
Severe, 100 C - 400 C	+0.2 dB	±0.2 dB

Indicators:

Digital: LED display, 4 digits, full-scale count of 1000.
Full 4-digit display with dBm option, 0.01 dB resolution.

Blanked at 105% of full scale and below 10% of full scale: decimal point, units, and polarity for dBm.
Analog: Miniature edgewise type, calibrated -9 to +3 dBm, 50 Q.

Waveform Response:

Input level 1 nW to 10 gW: True average power.
Input level above 10 YW: Average power of sine wave (true rms response changing to average, to peak, to peak-to-peak).

Analog Output:

0 to +10 volts on each range, proportional to the input power. Source resistance 9 kQ. 1 mA maximum into 1 kQ load.

VSWR:

	Model 41-4A	Model 41-4B	Model 41-4C	Model 41-4E
Input Zo	50	50	75	50
Freq. Range	0.2 MHz/7 GHz	0.2 MHz/12.4 GHz	0.2 MHz/ GHz	0.2 MHz/18 GHz
VSWR	< 1.3 to 4 GHz < 1.4 to 7 GHz	< 1.3 to 4 GHz < 1.4 to 11 GHz < 1.6 to 12.4 GHz	< 1.3 to 1 GHz	< 1.3 to 4 GHz < 1.5 to 10 GHz < 1.7 to 18 GHz

Data Outputs:

1-2-4-8 BCD data, serial by digits. 1-2-4 range information. Overrange, underrange, encode complete. Logic 0 < 0.07 V; logic 1, 2.4 to 5.25 V.

Power Detectors:

Input Connection: type N (Precision).
Output Connector: To fit 41-2A cable.
Dimensions: 1.5" (38 mm) diameter; 3.5" 90 mm) length.

Power Requirements:

115 or 230 V ±10%, 50 to 400 Hz, 15 W.

Dimension:

6.0" (152 mm) high, 8.3" (211 mm) wide, 12.0" (305 mm) deep.

Weight:

9.75 lbs. (4,5 kg) with cable and Detector.
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Accessories Supplied:

5-foot power detector cable Model 41-2A.

Equipment Options:

Model 42BD-01: Autoranging. Automatically selects the proper range for the applied input. Can be manually selected or programmed.

Model 42BD-08: Rear signal input option. A duplicate connector for the detector cable is provided on the rear panel of the instrument.

Model 42BD-09: Power/dBm readout option. Either power or dBm display manually selectable or programmed. Logic-level outputs indicate power and dBm.

Model 42BD-16: Serial to parallel BCD converter option. Rear plugin accessory to convert serial data output to parallel data output; DTL/TTL compatible.

CHAPTER III
OPERATION

3.1. INSTALLATION

Each instrument has been tested and inspected at the factory for compliance with all specifications before packing. Unpack carefully, saving all packing materials for possible future reshipping, and inspect the instrument for any signs of shipping damage. Should any damage be evident, notify the carrier and the factory immediately.

Although the Model 42BD is a simple instrument to use, and operation is largely self-evident, it is recommended that the Table of Controls and Functions, as well as the Operating Procedure, be studied before commencing operation.

Table 1
Controls & Functions

ITEM	FUNCTION
OFF/PWR/dBM	This switch controls the ac power to the instrument's power supply and includes the ZERO control.
FULL SCALE	These range push-buttons select the operating range of the instrument. They are arranged in the sequence 10 nW, 100 nW, 1 pW, 10 jW, 100 4W, 1 mW and 10 mW full-scale.
Indicator	Four-digit LED type readout, showing decimal point, units, and polarity for dBm (with dBm option).
Panel Meter	Edgemeter, calibrated from -l0to 0 dB Z used when zeroing instrument, and for peaking or nulling applications.

POWER DETECTOR	The Power Detector cable is connected to the instrument's input via this connector. It should be noted that if the instrument is a Model 42BD-08 option, there will be an additional input connector on the rear apron. The panel connector will have a screw-on shield cap; both input connectors are usable.
ZERO	This control, the center portion of the OFF/PWR/dBM switch, is used to zero the instrument electrically.
CAL FACTOR	This calibration factor control enables the operator to compensate for frequency effect. For a given measurement frequency, the control is set to the figure indicated on the chart found on the barrel of the Detector Head. The resultant reading may then be used directly, with no further correction.
	(The following items are on the rear panel.)
Fuse Holder and Fuse	This contains the ac line fuse - either a 0.2 ampere, 115 volt, or 0.1 ampere, 230 volt Bussman MDL SLO-BLOW fuse, or equivalent.
Slide Switch	This connects the power transformer primary windings either in parallel for 115 volt lines, or in series for 230 volt lines.
RECORDER	A dc voltage proportional to the applied power level is available at these terminals for connection to external devices. Full-scale output is +10 volts on each range. Output resistance is 9000 ohms.
Remote	A card-edge type connector is accessible through a slot in Connections the rear panel. The mating connector should be an Amphenol type 225-22221-101 or equivalent. See Figure 13 for pin designations.

This safety requirement has been adopted by the International Electro-technical Commission Document 66 (Central Office) 3, Paragraph 5.3, and indicates that it is necessary to refer to the instruction manual for correct use of the instrument.

3.2. OPERATION

The initial operating procedure detailed below should be followed carefully before attempting to use the instrument for measurement work.

3.2.1. Initial Operating Procedure

a. Compare the serial numbers of the Power Detector to be used and of the instrument; they should be the same. Each 42BD is calibrated with its own Power Detector; using another detector may result in measurement errors unless the instrument is recalibrated.

b. Check the setting of the power switch on the rear panel to be sure that it is set to the correct position for the power line voltage. See that the proper fuse for this voltage is in the fuseholder.

c. Connect the Power Detector cable to the Power Detector connector on the panel, tighten the knurled clamping nut firmly, and attach the Power Detector to the cable.

d. Set the CAL FACTOR control to 0 dBm.

e. Set the OFF/PWR/dBm switch to PWR and allow the instrument to warm up for a few minutes.

f. Depress the 10 nW FS button. With no signal into the Detector, the needle on the analog edgemeter can be adjusted with the ZERO control to the zero reference mark at the bottom of the scale. For greatest zero accuracy, however, adjust the ZERO control so that the "-" sign of the digital display flashes on and off at an equal rate. If the Detector is in a strong power-line or noise field, zeroing may be difficult. In this situation, refer to Paragraph 3.2.8 for shielding instructions.

It is important that the Detector be in thermal equilibrium. For this reason, prolonged handling of the Detector should be avoided before or during this adjustment.

3.2.2. Connection Recommendations

Although the Power Detectors are carefully insulated against external temperature variations, it is advisable to locate the Detector away from any sources of heat when using the most sensitive ranges. If monitoring the output of equipment which generates heat significantly above the ambient temperature, the Power Detector should be allowed to reach thermal equilibrium before making any measurements.

3.2.3. Low-Level Measurements

The Model 42BD will provide reliable, reproducible measurements of CW, AM, and FM power levels as low as 1 nanowatt (-60 dBm). It can also be used, although with slightly decreased accuracy (+1 dB) for pulse measurements. The peak power in this mode should not exceed 30 pW (-15 dBm), however. Above this level the detector enters the region where it ceases to function as a square-law detector; accuracy, except for CW and FM, cannot be guaranteed under these conditions.

When using the three most sensitive ranges (10 nW, 100 nW, and 1 4W), the preliminary zero adjustment is required. (Refer to Paragraph 3.2.1.)

3.2.4. High-Level Measurements

When using the higher ranges of the 42BD (10 pW to 10 mW), it is not necessary to make the zero adjustment. As noted in Paragraph 3.2.3 above, accuracy cannot be guaranteed when measuring pulse power with peaks exceeding 30 4W. For CW and FM power, measurements within the specified accuracy will be obtained up to 10 mW.

3.2.5. High Frequency Measurements

To obtain the specified accuracy of the 42BD at frequencies above 1 GHz, reference must be made to the correction chart on the barrel of the Power Detector. This curve, which is individually determined for each Power Detector, presents a correction factor vs frequency which must be applied to the instrument reading. While this can be done by adding algebraically the correction to the reading, use of the CAL FACTOR control automatically inserts the correction and enables the operator to read the meter directly. This control is adjusted as follows:

Read the correction to be applied at the frequency of operation from the curve on the Detector barrel. Use a straight-line interpolation if the frequency of operation is between specified frequencies. As an example, say that the correction value is +0.2 dBm. Set the CAL FACTOR control to +0.2 dBm. All values thereafter, at that frequency, are then read directly from the meter, with no further correction needed. Note that if the frequency of measurement is changed, a new CAL FACTOR setting will be required.

The performance of the Model 42BD at high frequencies is described in terms of measurements called Calibration Factor and Effective Efficiency. The following paragraphs define these terms, explain their use, and describe the procedures required for their determination.

NOTE:

The Model 41-4A, 41-4B, and 41-4E Power Detectors are calibrated for use with a 50-ohm source. Large deviations from 50 ohms may give rise to serious errors from mismatching and increased vswr. This effect can be reduced by inserting a low-vswr attenuator (vswr < 1.10) between the source and the Power Detector; an alternate would be the insertion of a low loss tuner.

The Model 41-4C Power Detector is calibrated for use with a 75-ohm source. The same comments apply in this case.

3.2.5.1. Calibration Factor and Effective Efficiency

Power measurements are made on either a Z match or on a conjugate match basis. On a Z match basis, the measured power is given by:

$$P_{meas} = \frac{(l \pm e) K_b P_o}{[1 - r_g r_m]^2}$$

Where P_{meas} = measured power
e = low frequency instrumentation error
r_g = complex generator reflection coefficient
r_m = complex power reflection coefficient
P_o = power that would be delivered to a perfect Z load
K_b = calibration factor

If the generator source impedance or power meter head provides a perfect Z match, the term Il- r is unity. In all other cases, either the complex reflection coefficients have to be measured for the most accurate measurements or the uncertainty of the measurement inherent in this term has to be accepted. Figures 1 and 2 show this uncertainty expressed either in dB or percentage terms of the source VSWR and load VSWR, recalling that

$$VSWR = \frac{1+[r]}{1-[r]}$$

In addition to the uncertainty, the mismatch loss associated with the power meter head is described by the calibration factor K_b where

$$K_b = \frac{\text{Indicated Power}}{\text{Incident Power}}$$

When power measurements are made on a conjugate match basis, the measured power is given by

$$P_{meas} = (1-e)K_T n P_c$$

where e = low frequency instrumentation error
K_T = tuner transmission characteristic
$= \frac{\text{power delivered by tuner to load}}{\text{power delivered to tuner input}}$

P_c = power that would be delivered to a perfect conjugate load

n = effective efficiency

The effective efficiency n is described by:

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Uncertainty - DB $\frac{1}{(1 \pm |\Gamma_G| \; |\Gamma_L|)^2}$

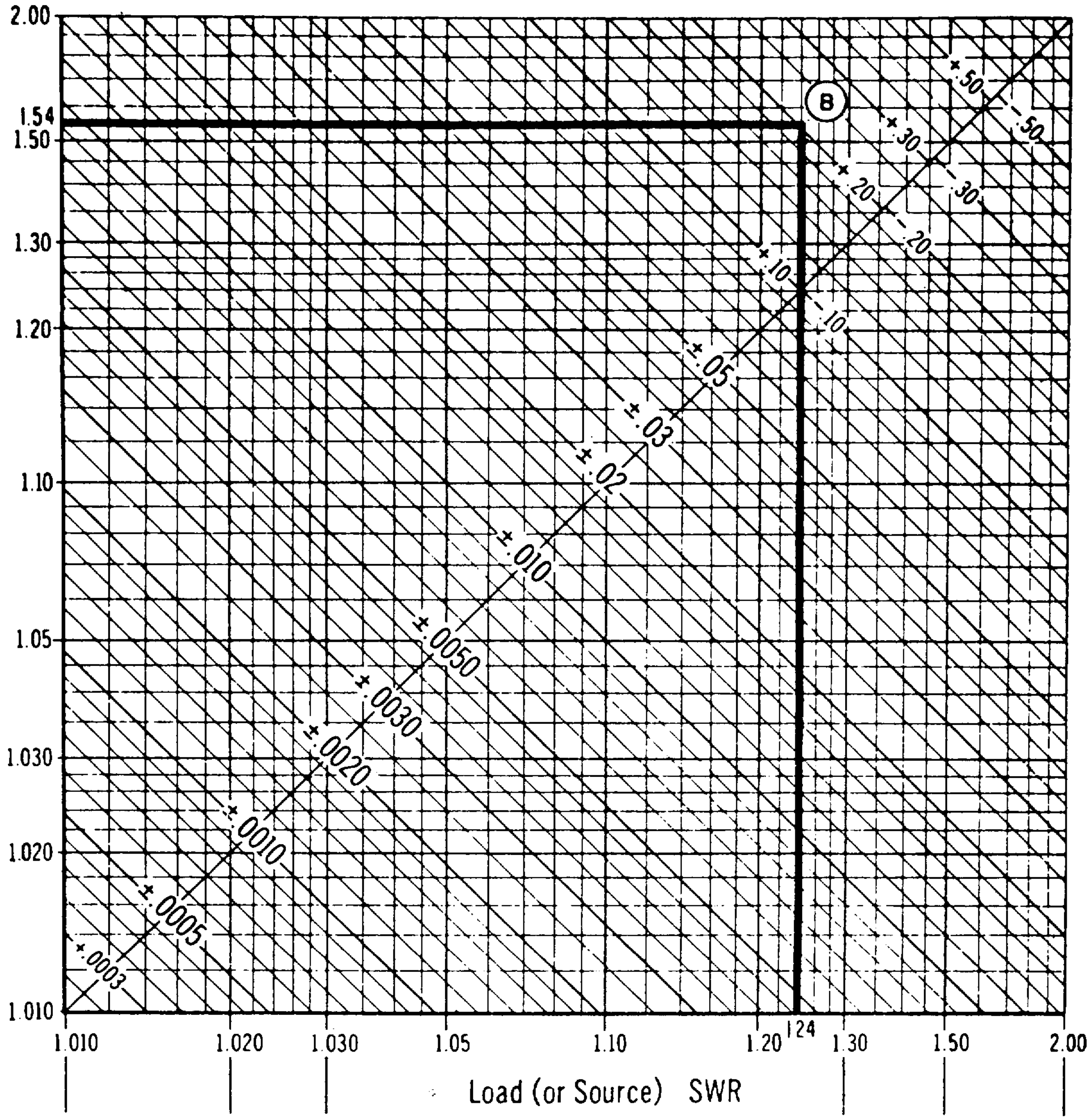

Figure 1.

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Uncertainty - DB $\dfrac{1}{(1 \pm |\Gamma_G|\ |\Gamma_L|)^2}$

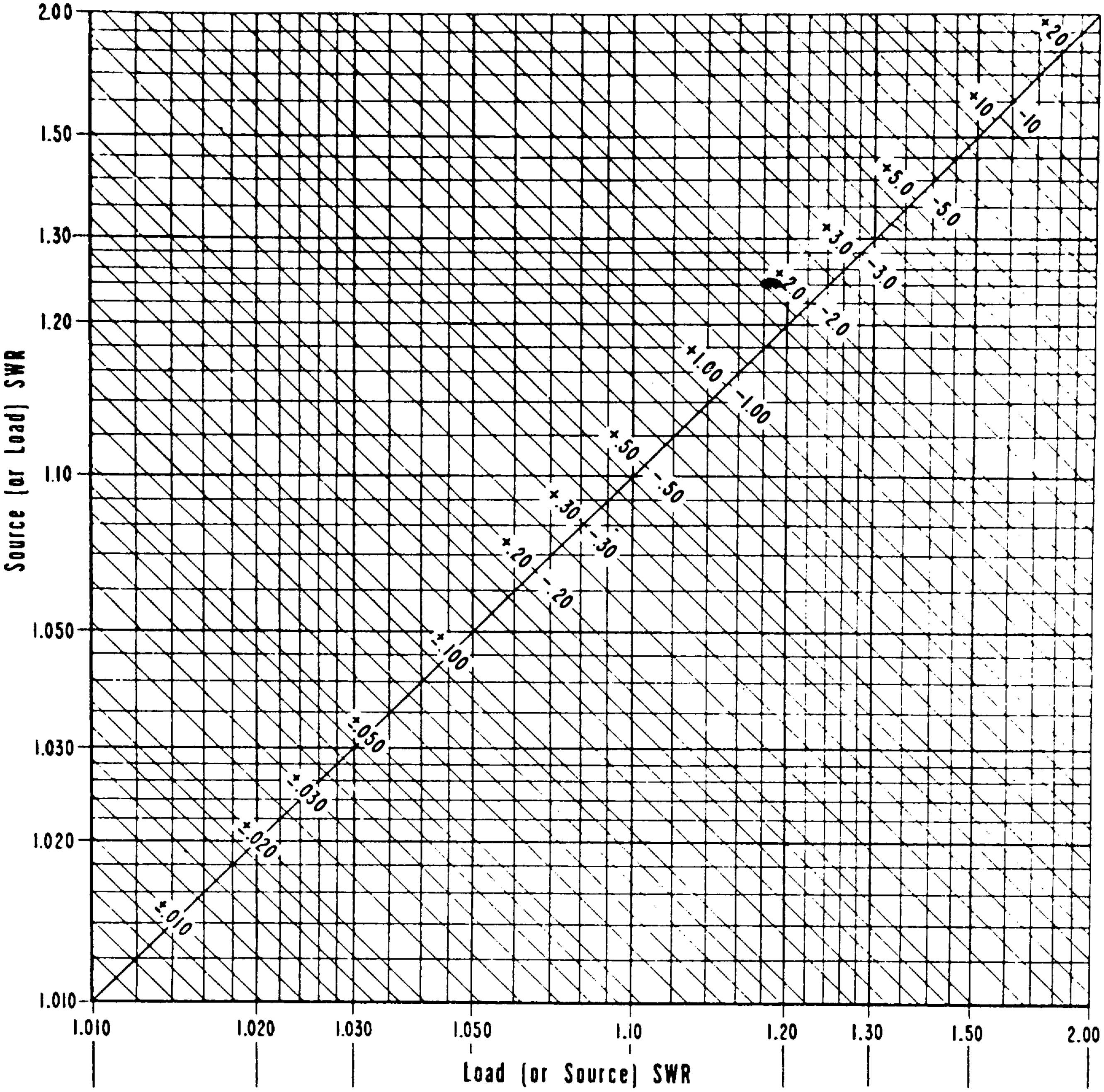

Figure 2.

42BD
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$$n = \frac{\text{Indicated Power}}{\text{Dissipated Power}}$$

The calibration factor and effective efficiency are related by the following equation:

$$K_b = (1 - [r_m]^2)\, n$$

where $|r_m|$ is the absolute value of the power detector reflection coefficient.

3.2.5.2. Determination of Calibration Factor

Required equipment:

1. Standard Power Meter. This is any suitable instrument (BE42, HP 432, Gen. Micro. 454, PRD 6685, Narda 443, etc.) whose power head has been certified for Calibration Factor K_S by standards traceable to National Bureau of Standards (NBS) and whose low-frequency instrumentation error (e_1) is known.
2. Generator (covering frequencies and power ranges of interest).
3. Double-stub Tuner, Narda 903N.
4. Directional Coupler, HP 11692D.
5. Precision Termination, Weinschel Model 1404.
6. 6 dB pad, Weinschel Model 1.
7. Model 42 Power Meter (accuracy of calibration not important).
8. Model 42BD to be calibrated.
9. 50-ohm Termination, HP909A.

Connect the equipment as shown in Figure 3a and proceed as follows:

1. Adjust the generator (2) to a convenient low frequency and a level sufficient for a stable reading on the Model 42 (7).
2. Adjust the double-stub tuner (3) for a maximum indication on the Model 42 (7).
3. Replace the precision termination (5) with a standard power meter (1). (See Figure 3b.) With generator (2) set at the same frequency as in Step 1, adjust the generator output level for a convenient reading on the standard power meter (1). Record the output reading of the Model 42 (7). Record the indicated reading on the standard power meter (1) as (P_{ind_1})

4. Replace the standard power meter with the Model 42BD (8). (See Figure 3c.) With generator (2) set at the same frequency as in Step 1, adjust the generator output level until the Model 42 (7) reads the same value as recorded in Step 3. Record the indicated power reading on the Model 42BD (8) as P_{ind_2}

The calibration factor (K_b) is now computed from the relationship:

$$K_b = \frac{(1 \pm e_2)\ (^P ind_2)}{K_s\ (1 \pm e_1)\ (^P ind_1)}$$

where K_s = calibration factor of standard power meter (1)

e_1 = instrumentation error of standard power meter (1) for the range used

$^P ind_1$ = indicated power reading on standard power meter (1) ind1

e_2 = instrumentation error of the Model 42BD (8) for the range used as determined in performance checks, Paragraph 5.4

$^P ind_2$ = indicated power reading of Model 42BD (8) ind2

The CAL FACTOR control on the 42BD front panel is calibrated in terms of K_b expressed in dB. For example, if K_b = 1.023, the 42BD cal factor will equal -10 LOG K_b or -0.1 dB.

NOTE:

It is important that the instrumentation error (e) of the standard power meter (1) be known completely. For bolometer and thermocoupletype power meters, this error usually can be determined by the dc substitution methods, as described by the manufacturers. In most cases the uncertainty of instrumentation error can be reduced by operating at higher power levels.

At all other frequencies of interest, repeat steps 1 through 4 and compute the calibration factor (K_b) for each frequency used.

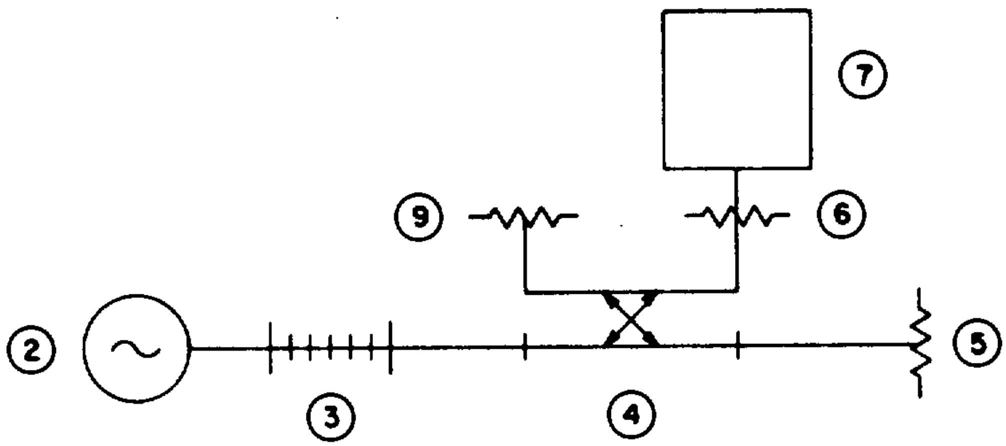


Figure 3a.

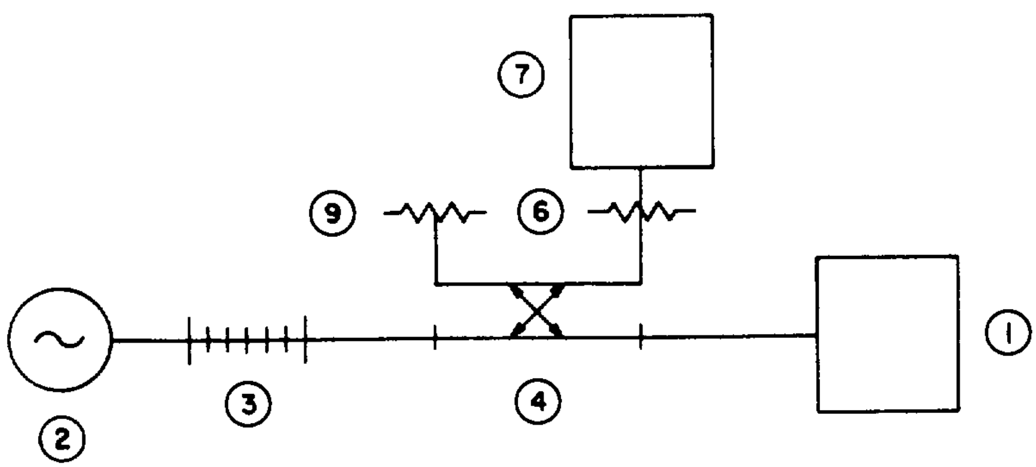


Figure 3b.

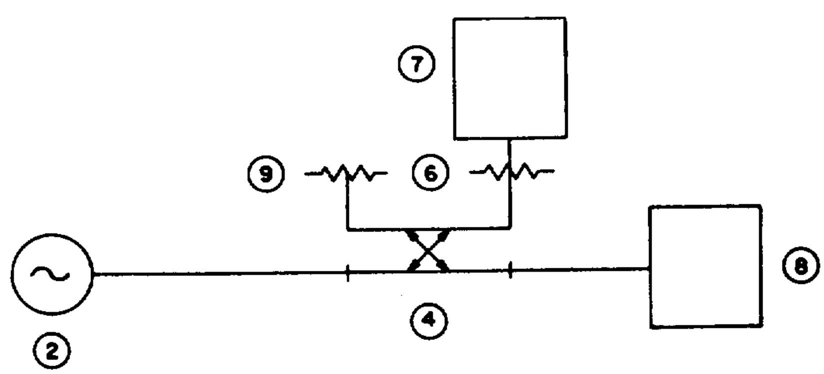


Figure 3c.

3.2.5.3. Determination of Effective Efficiency

Required equipment:

1. Generator (covering frequencies and power ranges of interest)
2. Directional Coupler, HP 11692D
3. Two 6 dB pads, Weinschel Model 1
4. Two Model 42 Power Meters
5. Model 42BD to be calibrated, whose Calibration Factor has been determined in accordance with Paragraph 3.2.5.2

Connect equipment as shown in Figure 4.

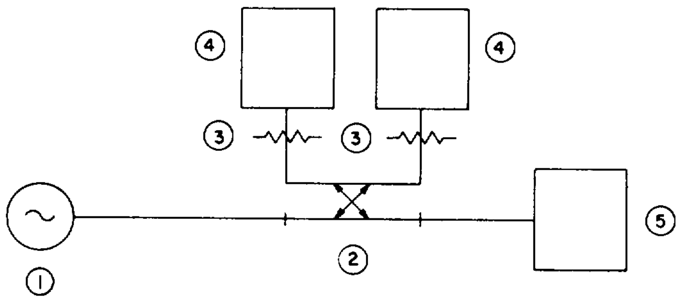


Figure 4.

1. Set the generator to the first frequency of interest and increase its output level until there is a convenient reading on the Model 42BD (5).

2. Measure the incident power on one Model 42 (4) and the reflected power on the other Model 42 (4) and record these values as $P_{incident}$ and $P_{reflected}$. In recording these values, adjust the values to compensate for any differences between the correction factors of two 6 dB pads (3) and for the CAL FACTORS of the two power meters at the frequency under study.

3. Calculate the magnitude of the reflection coefficient Γ_m of the Model 42BD (5) in accordance with:

$$[\Gamma_m] = \frac{P_{reflected}}{P_{incident}}$$

The effective efficiency (ri) is now given by

n = Kb
   1-[rm]2

where Kb is the calibration factor as determined in Paragraph 3.2.5.2. At all other frequencies of interest, repeat steps 1 through 3 and compute the effective efficiency (n) for each frequency used.

3.2.6. Temperature Effects

The accuracy specifications for the Model 423D apply over an ambient temperature range of 180 C to 300 C. Operation outside this temperature range is possible, but some inaccuracy can be expected. Figure 5 shows a typical temperature characteristic of a Power Detector, and Figure 6 shows that of a Model 42BD and Power Detector together.

NOTE:
For best zero stability, the Power Detector and instrument should be allowed to reach a stable temperature.

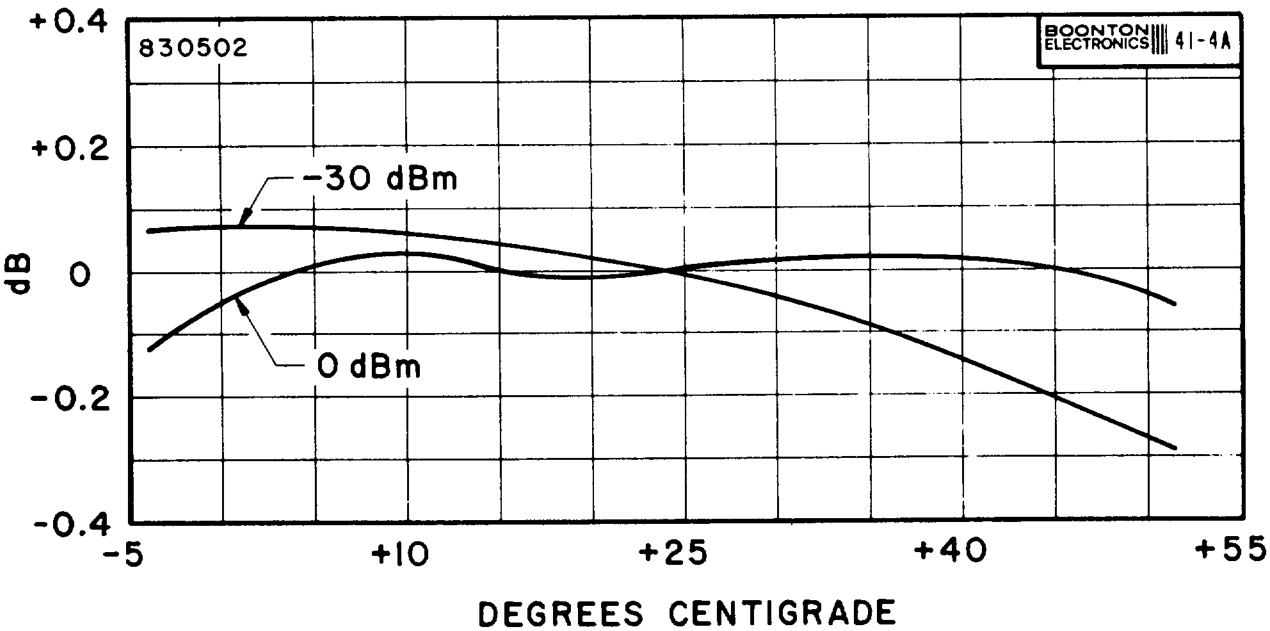


Figure 5. Typical Temperature Characteristic

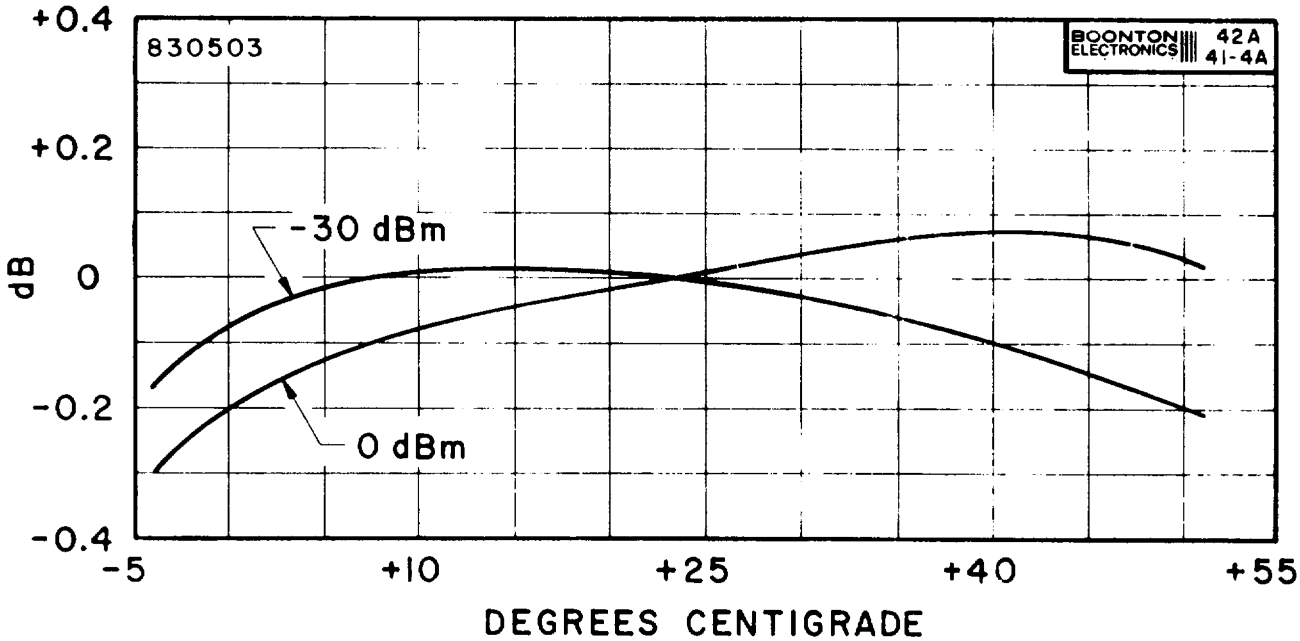


Figure 6. Typical Temperature Characteristic

3.2.7. VSWR Measurements

The high upper-frequency limits and the sensitivity of the Model 42BD make it a useful instrument for measuring vswr with a slotted line. As this type of measurement requires only comparative, rather than absolute, values, the 41-4B Power Detector may be used up to 18 GHz 'up to 20 GHz with the Model 41-4E Detector).

VSWR is determined by measurinr the dB difference between a maximum and a minimum indicated power point on a slotted line and converting this difference to vswr. An adapter is needed to couple the instrument to the slotted line; these are usually available from the manufacturer of the particular slotted line used.

Slotted-line vswr measurements may be made as follows:

1. Connect the Power Detector to the sliding carriage, using a suitable adapter.
2. With the signal source OFF, zero the Model 42BD.

3. Turn the signal source on, and slide the carriage along the line until a point of maximum reading is located.
4. Adjust the source level and the probe setting for the leasting coupling that will yield a reading of -41 dBm. (The incident power should be 0 dBm or greater.)
5. Slide the carriage along the line to lcate a point of minimum reading. Note the meter reading (dBm) at this point, then subtract this minimum reading from the maximum reading. Convert the resultant AdB into vswr either by the use of the vswr Conversion Curve (Figure 7) or by computation.

NOTE: VSWR is the antilog, base 10, of ΔdB/20.

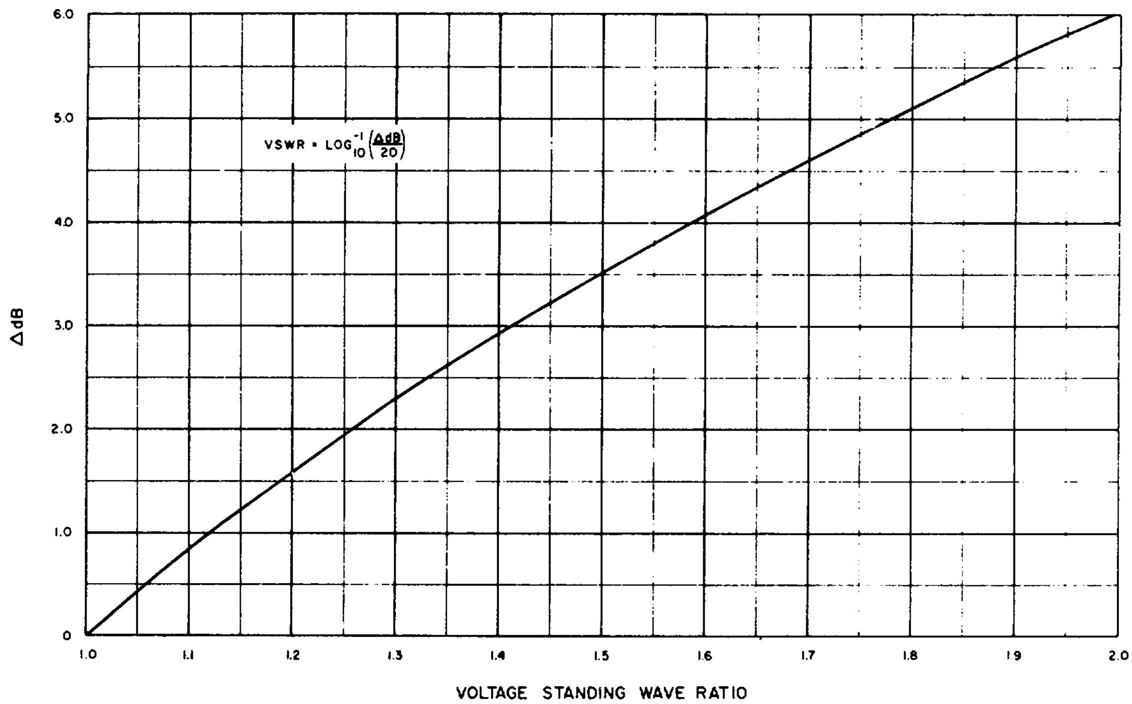


Figure 7. dB-VSWR Conversion Chart

3.2.8. Shielding Recommendations

As mentioned in Paragraph 3.2.3, the preliminary zero adjustment is required when the instrument is to be used on the three lowest ranges or when first setting up. Difficulty may be experienced in zeroing if the instrument is subjected to strong noise fields (See Paragraph 3.2.1.f), making it necessary to shield the input to the Power Detector for this adjustment.

The simplest method of shielding the Detector is to connect it to the device being used, making sure that the device is first turned off. Occasionally, however, the device itself will act as an antenna and actually introduce the noise voltage into the Detector. Should this be the case, stand the Detector vertically on a copper plate, holding it down firmly so that the rim of the connector body is in good contact with the copper at all points. An alternative is to wrap a piece of thin copper foil around the barrel of the connector body, and crimp or fold it around the open end of the connector. (Do not short the center-pin, however.) If this will be a frequent occurence an adapter can be made up with a mating Type N connector permanently fitted with a copperfoil shield.

3.2.9. Over/Under Range Indication

When the power applied to the Detector is approximately 5% above the maximum of the range in use, or 12% below the minimum, the digital display will blank out. An upward or downward pointing arrow indicator will appear, to show the direction of the required range change. In instruments with autoranging option, this range switching will be automatically controlled by the indicator circuits when the instrument is in the autorange mode.

3.2.10. Analog Output

The dc output voltage at the RECORDER terminals on the rear panel is directly proportional to the power level at the Power Detector input. It is positive with respect to chassis ground, with a maximum value of 10 volts at full-scale on all ranges.

The voltage is linear with respect to power down to about 10% of full scale (the point where the digital display blanks out). Linearity is not specified below this point, and the operator should switch the instrument to the next lowest scale. Terminal 20 on the rear card-edge connector is at Logic 1 (about +4 volts) when the applied signal goes below range and the indicator blanks. Connection 21 operates in similar fashion for over-range indication. If desired, these outputs can be used to operate an external warning device to alert the operator that the dc output has entered an unreliable region.

3.2.11. BCD Output

Serialized binary-coded-decimal output (4-line, 8, 4, 2, 1) is available at the rear edge-connector, together with BCD command inputs. Output information includes range, digits, over-range, and under-range indications, mode, and encode complete. Logic 0 < 0.7 V, and Logic 1 is 2.4 to 5.25 V.

3.2.12. Programming

Logic-level inputs to the appropriate pins on the rear edge-connector select ranges and modes, encode hold, encode trigger, manual disable. Logic levels are standard TTL inputs; logic level 0 (< 0.7 V) enables a function, while logic level 1 (2.4 to 5.25 V) disables it.
Chapter 6 of this manual (Interface Information) contains detailed information on input and output signal characteristics.

3.2.13. Autoranging Option (42BD-01)

The instrument can be operated in the automatic ranging mode by pressing the AUTO switch button on the panel, or by grounding the appropriate pin on the card-edge rear connector. With this option, the range is automatically switched up or down as the applied power approaches triggering points slightly above or below the calibrated range. These triggering points are carefully adjusted at the factory to ensure that there is adequate overlap between adjacent ranges.
NOTE: The instrument must be zeroed in the normal mode before selecting the autorange mode.

When the 42BD-01 forms part of an external test system, the application of a Logic 0 (< 0.7 V) to pins 6 (Auto Enable) and 7 (Manual Disable) will place the instrument in the Autorange mode.

3.2.14. dBm/Power Readout Option (42BD-09)

With this configuration, the readout can be switched to indicate either power or dBm. The switching can be done either manually or by logic-level command inputs.

CHAPTER IV
THEORY OF OPERATION

4.1. GENERAL

The block diagram (Figure 8) illustrates the essential portions of the 42BD configuration. Detailed schematic diagrams of the several sections of the instrument, and of the options available, will be found at the back of this manual. A brief description of the circuit operation on a sectional basis follows.

4.1.1. Power Detector

The Power Detector contains a non-inductive load resistor of 50 ohms (75 ohms in the 41-4C) and a pair of selected diodes connected as a full-wave rectifier across the resistor. The rf voltage appearing across the resistor is rectified by the diodes, producing a dc voltage whose level is a function of the power applied. When the applied power is within the square-law region of the diodes (approximately 10 microwatts), the detector shows true rms response. Above this power level the response approaches peak-to-peak, calibrated on the indicator in terms of rms power. The use of full-wave rectification permits the measurement of highly asymmetrical wave-forms without substantial error.

The body of the detector is very carefully designed and fabricated to eliminate any cavity resonance effects within the calibrated frequency range. Special diodes are selected for this application; they should not be replaced with off-the-shelf types by the user in cases of accidental burnout. Detailed replacement and repair procedures will be found in the Maintenance section of this manual.

4.1.2. Chopper and Chopper Driver

The chopper-driver block provides all of the drive signals required by the instrument. The chopper frequency is obtained by dividing the output of

830508

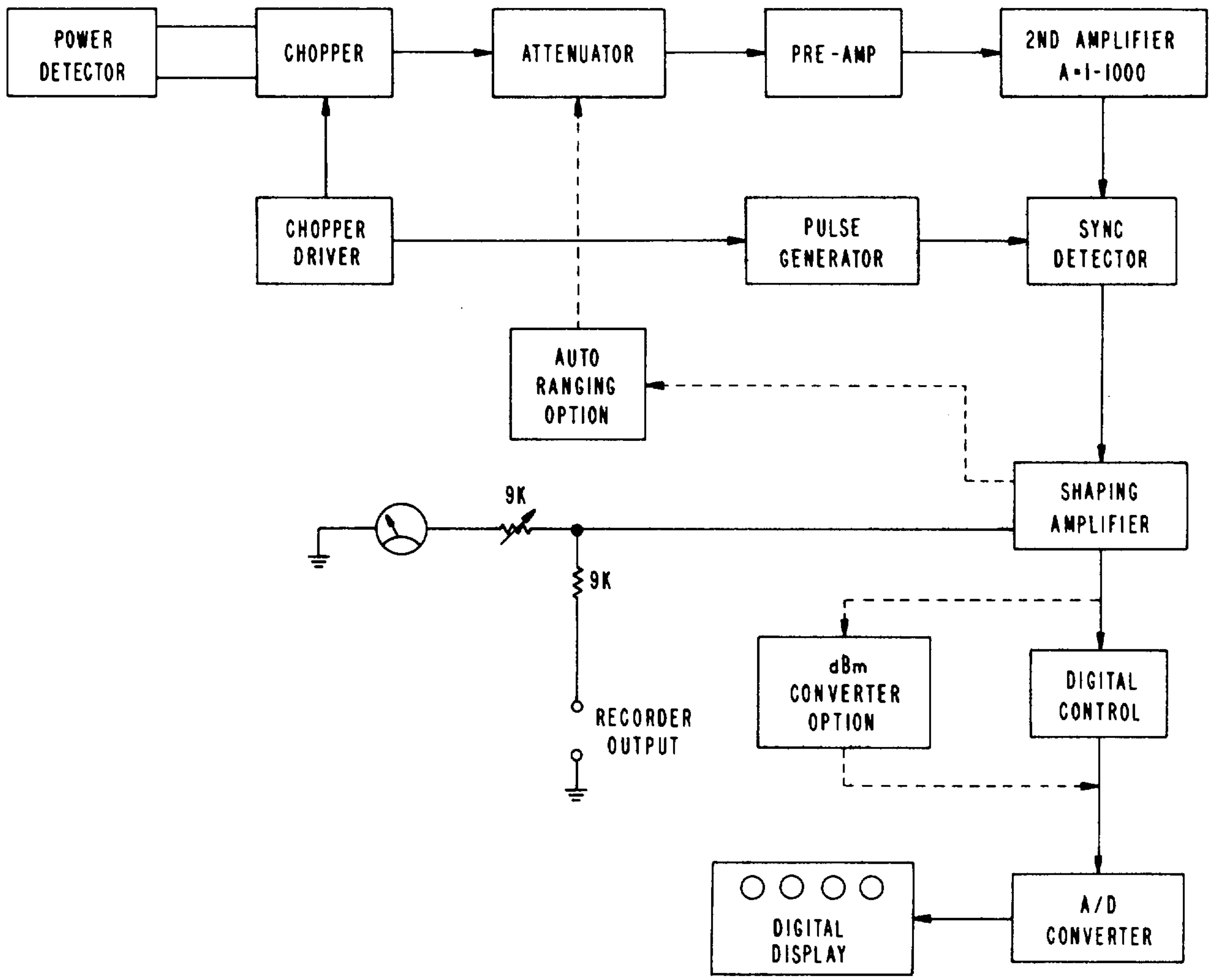


Figure 8. Block Diagram

a unijunction oscillator by two. The oscillator also generates the switching pulse for the synchronous detector. Diode gating feeds the pulse to the proper JFET depending upon chopper phase. The chopper frequency is normally adjusted to 94 Hz, but can be changed ±10 Hz to avoid beating with harmonically related power-line-frequency ground currents.

4.1.3. Attenuator and Amplifiers

The ac voltage from the chopper is applied to the attenuator and amplifier sections. The pre-amplifier, with a constant gain of 100X is designed for very low noise. The second amplifier is designed to show an output of 3 volts peak-to-peak at full scale for each range; this is done by ranging both the attenuation and the gain of the second amplifier. Both amplifiers are stabilized by large amounts of inverse feedback and exhibit moderately wide bandwidths.

4.1.4. Synchronous Detector

The amplified signal from the second amplifier is converted to dc in the synchronous detector. This detector is driven by pulses triggered by the chopperdriver circuit, assuring accurate synchronization. The peak-to-peak amplitude is derived from a shunt-series capacitor storage circuit using JFET switches.

The characteristics of the detector determine the effective bandwidth of the amplifier-detector combination, and allow modifications of the bandwidth for different range conditions. The detector also provides conversion without offset, with excellent linearity.

4.1.5. Shaping Amplifier

The conversion of rf to dc in the power detector is non-linear, the response being virtually square-law for the lowest ranges and gradually becoming quasi-linear for the 10 mW range. The shaping amplifier converts the non-linear output of the detector to a linear output by using a segmental approximation to the exact correction. The shaping amplifier is an operational amplifier connected so that, as the signal increases at its output, its gain is reduced by successively paralleling resistors across the feedback resistors. The number of segments needed adequately to linearize the response varies from 0 for the "square-law" ranges up to 6 for the 10 mW range. The output of the shaping amplifier at full scale is +10 volts; this voltage is applied to the miniature panel meter, the RECORDER terminals through a 9 kQ resistor, and to the digital control circuits.

4.1.6. <u>Digital Control</u>

The analog dc signal from the shaping amplifier is processed by the digital control circuits before being passed on to the analog-digital converter and the digital display unit. The digital control section divides the incoming voltage (10 volts full scale) by a factor of 20. It extracts information for the control of range, decimal point position, over- or under-range indications, polarity indication and mode indication. (On the 42BD-09 Option, this section also contains the additional circuitry to convert the incoming power information to dBm values.) The processed analog signal is then passed to the analogdigital converter section.

4.1.7. <u>Analog/Digital Converter</u>

This is a dual-slope type of converter; incoming analog information is changed to digital form and applied to the digital display unit, where the appropriate segments of the LED display are triggered. These show not only numerals, but also over or under-range indication, polarity, and units (nW, 4W, mW, dBm).

4.1.8. <u>Power Supply</u>

The power supply converts the ac line power to regulated +15 and -15 volt outputs. Each supply is protected by current limiting against accidental short circuits, and each is adjustable to within ±0.1 volt.

4.1.9. <u>Programming</u>

The 42BD is organized around an eight-line ranging system. In each functional subcircuit, switching is accomplished by solid-state devices, generally FETs, which are actuated by grounding the appropriate range lines. The front panel ranging switch simply connects to the eight range lines to allow range selection. The range lines are buffered by a logic-level converter. The instrument may be externally ranged by applying a logic "0" command to the desired range line and the manual disable line.

CHAPTER V
MAINTENANCE

NOTE:
Values and tolerances shown in this section are not specifications but are provided only as guides to the maintenance and calibration of this instrument.

5.1. Introduction

The Model 42BD, hereinafter called the instrument, is designed conservatively and, in normal usage, should provide trouble-free operation for long periods of time. However, as with any precision instrument, it should have its calibration checked periodically to ensure that the specified accuracy is maintained. This section contains information necessary to make performance checks, adjustments when needed, and to perform troubleshooting and servicing. Complete schematic diagrams are found at the back of this manual and should be referred to when servicing is performed.

5.2. Test Equipment Required

The test equipment needed to check and maintain the instrument is listed in Table 1. Comparable equipment with equal or better specifications may be substituted for any of the items listed.

Table 1. Test Equipment

Instrument	Characteristics	Model
DC Power Source	0 to 10.0 volts, 0 to 5 amperes, load regulation 5 mv, 0.01% current plus 250 WA	Hewlett Packard HP6218A
Test Oscillator	Frequency: 10 Hertz to 10 Mega-Hewlett Packard hertz in 6 ranges, ±3% of frequency setting. Output -70 dBm to +23 dBm	

Table 1. Test Equipment (continued)

Instrument	Characteristics	Model
Micropotentiometer	0.17 to 440 millivolts	Ballantine Labs Model 440 including 5 and 15 milliampere thermocouples and three radial resistors: 0.15 ohms, 1.5 ohms and 15 ohms respectively
DC Meter No. 1	100 millivolts, and 1, 10, 100, and 1000 volts full-scale. Input impedance greater than 1000 megohms on on 100 millivolt, 1 and 10 volt ranges; greater than 10 megohms on 100 and 1000 volt ranges	Hewlett Packard HP2402A, Integrating DVM (pad for Zi = 50 ohms)
DC Meter No. 2	Voltmeter: +3 microvolts to ±1000 volts dc, 18 zero center ranges, +2% of ranges Ammeter: ±30 picoamperes to ±30 nanoamperes in zero center ranges i3% of range up to 1 volt	Hewlett Packard HP419A dc Null Voltammeter
Thermal Voltage Converter (TVC)	Model 1393-1	Ballantine Labs Thermal Voltage Converter
Oscilloscope	DC to 10 Megahertz; y axis 50 mV division; x axis lms/lOms division	Tektronix Model 531
Card Extender	--- --- ---	Boonton 92-6A

Table 1. Test Equipment (continued)

Instrument	Characteristics	Model
Frequency Counter	5 Hz to 40 MHz	Monsanto Model 1003
Voltohmmeter	20,000 ohms per volt dc; 1000 ohms per volt ac; volts ac and dc 0-1000 In 5 scales; output 2.5 to 100 in 4 scales; amps 100 A to 10 A in 5 scales; ohms 0-20 megohms in 3 scales	
DC Digital Voltmeter (DVM)	1 vfs to 15 vfs 4-1/2 digits 0.05% accuracy	Fluke Model 8001A

5.3. Calibration Precautions

When checking an instrument having the sensitivity and bandwidth of the Model 42BD, it is essential to take precautions against errors resulting from stray pickup. A well shielded signal source must be used together with coaxial connections.

5.4. Performance Checks (PWR)

Because of the outstanding low-frequency response of the instrument (200 kHz as opposed to the usual 10 MHz of competitive instruments) it is convenient to check the performance by using voltage sources in the frequency range of 200 kHz to 1 MHz. In this range, there are commercial sources and reference standards available with the required accuracy. Figure 9 shows the suggested equipment and connections to check all ranges of the instrument, except the +10 dBm range; Figure 10 shows the suggested equipment and connections to check the +10 dBm range.

NOTE :

Prior to proceeding with performance checks, accomplish the initial operating procedures set forth in Paragraph 3.2.1.

NOTE:

The Boonton Model 25A Power Meter Calibrator can be substituted for the equipment shown in figures 9 and 10. This calibrator provides 1 MHz power levels from -69 to +20 dBm in 1 dB steps with 0.05 dB uncertainity. If the Model 25A Calibrator is used, disregard all references in paragraphs 5.4 and 5.5 to equivalent voltage levels; merely refer to specified power levels which then can be switch-selected on the Model 25A.

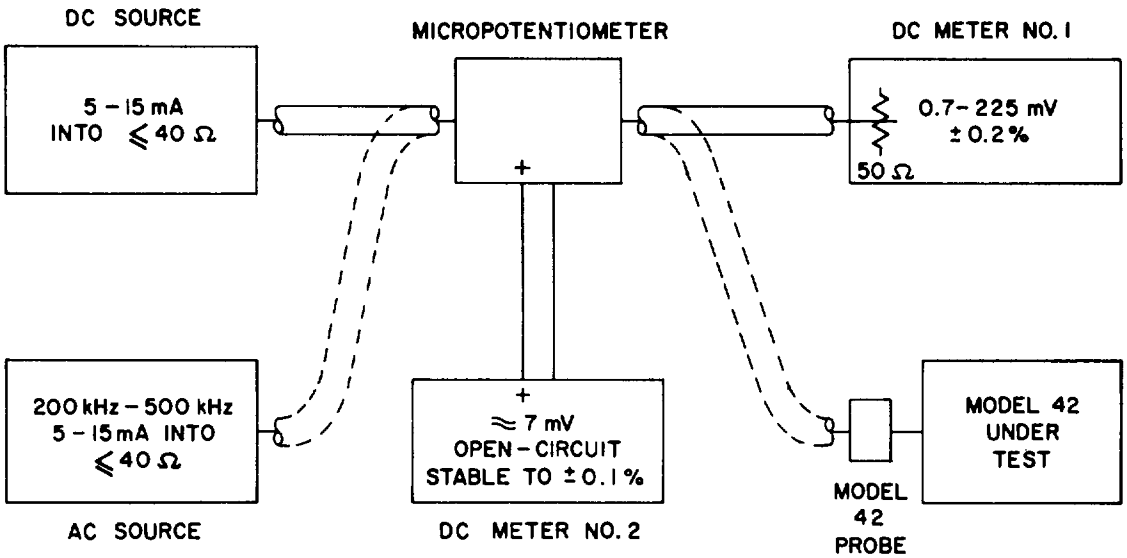


Figure 9. Connections

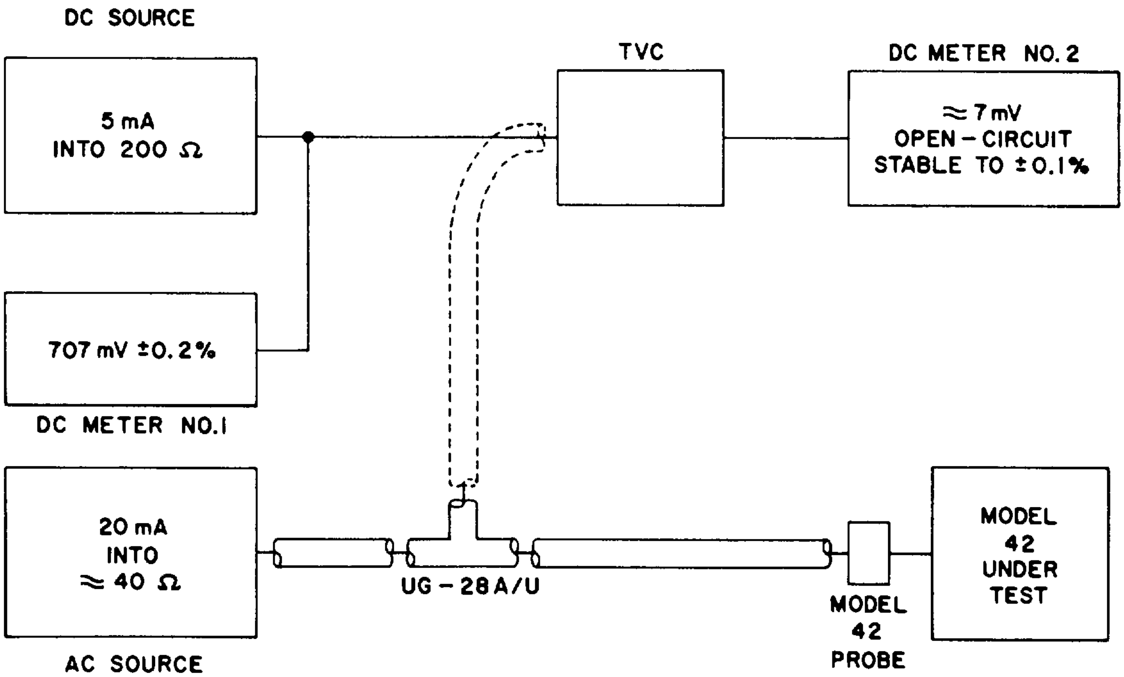


Figure 10. Connections

5.4.1. Performance Check Procedure (all ranges except 10 mW)

Each range is checked by connecting the Model 440 micropotentiometer (using the appropriate thermocouple and radial resistor) to the dc power source and dc meter No. 1 (Figure 9) and adjusting the dc power source until the dc meter No. 1 reads the voltage equivalent to the full-scale power for that range (refer to Table 2). Record the dc meter No. 1 reading. Now connect the micropotentiometer to the ac power source and the Model 42BD under test. Adjust the ac power source until the dc meter No. 2 indicates the same value as recorded for the dc meter No. 1. The RMS output voltage of the micropotentiometer is now equivalent to the recorded dc voltage. The Model 42BD should now read full scale within the specified tolerance (±5% for the PWR mode; ±0.2 dBm for the dBm mode). Perform the steps listed in Table 2 to check performance.

5.4.2. Performance Check Procedure (10 mW range only)

a. Connect the instrument to test set-up as shown in Figure 10. Depress the 10 mW button of the FULL SCALE range selection.

b. Adjust the dc power source until the dc meter No. 1 reads 707 mv. Record the reading of the dc meter No. 2.

c. Connect the ac source to the ac source tee (UG-28A/U) as in Figure 10.

d. Adjust the ac source for an output so that the reading of dc meter No. 2 is equal to that obtained in Step b. above. The RMS voltage now connected to the instrument has a value equivalent to the 707 mv reading of the dc meter No. 1. The reading displayed should now read full scale, 10 mW ±5% in the PWR mode or + 10 dBm +0.2 dBm in the dBm mode.

5.4.3. dBm Performance Checks

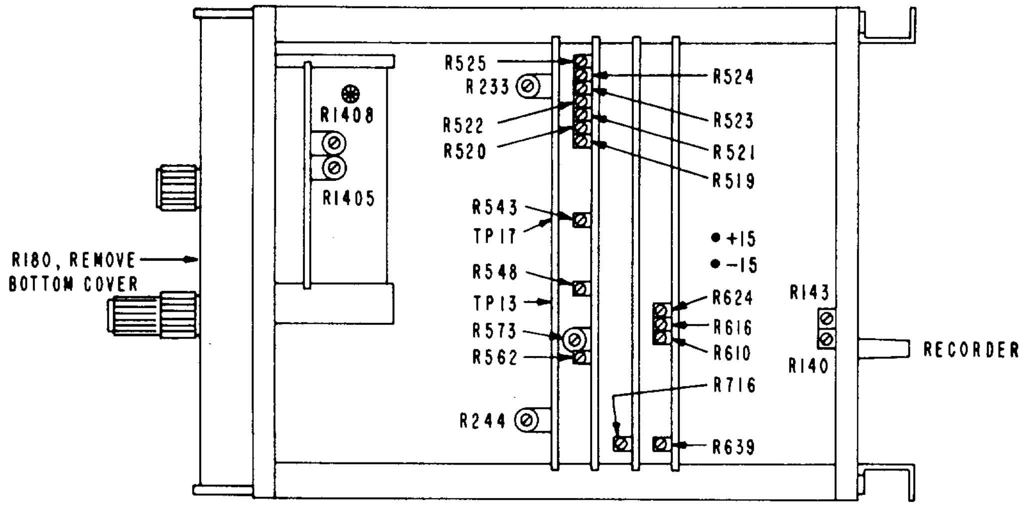
NOTE:

These adjustments are not normally required. The instrument should be tested in the PWR mode before the dBm performance checks. See Figure 11 for the location of boards and test points.

Table 2. Performance Check

				Model 42BD Microwattmeter				
	Model 440				Power Reading ±5%		dBm Reading ±0.2 dBm	
	Micropotentiometer		DC Meter No. 1	Push FULL SCALE Button	OFF/PWR/ dBm Switch Position		OFF/PWR/ dBm Switch Position	
Step	Resistor	Thermocouple				Display		Display
*1	0.15 ohm	5 mA	0.707 mV	10 nW - -50	PWR	10.00 nW	dBm	-50.00 dB
*12	0.15 ohm	15 mA	2.236 mV	10nW - -40	PWR	100.0 nW	dBm	-40.00 dB
*3	1.5ohms	5 mA	7.071 mV	1 -W - -30	PWR	1.000nW	dBm	-30.00 dB
4	1.5ohms	15 mA	22.36mV	10 -W - -20	PWR	10.00 W	dBm	-20.00 dB
5	15ohms	5 mA	70.71mV	1004W - -10	PWR	100.0 W	dBm	-10.00 dB
6	15ohms	15 mA	223.6mV	1 mW - 0	PWR	1.000mW	dBm	.00 dB

*Preliminary zero adjustment required. (Refer to paragraph 3.2.1.)



⊛ FACTORY ADJUSTMENT: REFER TO MANUAL
● TEST POINT
+ REPEAT STEP #4
✱ INSTRUMENTS WITH dB OPTION ONLY
VOLTAGE LEVELS FOR 50 OHM SYSTEM

ADJ NO	CONT	FUNCTION	RANGE	INPUT PWR ±0.2% (50 OHMS)	ADJUST
1	R143	−15V ADJ	—	0	−15.0V ±0.1V AT −15V TP
2	R140	+15V ADJ	—	0	+15.0V ±0.1V AT +15V TP
3	R244	CHOPPER FREQUENCY	1 μW	1 μW (7.071 mV)	94±1Hz AT TP 13
4	R401	FRONT PANEL ZERO	10 nW	0	AVERAGE ZERO INDICATION AT RECORDER TERMINALS
5	R233	DC ZERO	1 μW	0	ZERO INDICATION AT RECORDER TERMINALS
6+	R180	MAIN GAIN	1 μW	1 μW (7.071 mV)	−3.00 VDC AT TP17
7+	R523	FS RANGE ADJ	1 μW	1 μW (7.071 mV)	+10.00V AT RECORDER TERMINALS DC VOLTMETER INPUT >10 M OHMS
8	R1405	+DPM FS ADJ	1 μW	1 μW (7.071 mV)	1.000 μW INDICATION
9	R639	EDGEMETER ADJ	1 μW	1 μW (7.071 mV)	ZERO dBm INDICATION
10	R716	AUTORANGE TRIP ADJ	AUTO	1−1.1 μW	TRIP TO 10 μW RANGE AT 1.03 μW
11+	R525	FS RANGE ADJ	10 nW	10 nW (0.707 mV)	10.00 nW INDICATION
12+	R524	FS RANGE ADJ	100 nW	100 nW (2.236 mV)	100.0 nW INDICATION
13	R522	FS RANGE ADJ	10 μW	10 μW (22.36 mV)	10.00 μW INDICATION
14	R521	FS RANGE ADJ	100 μW	100 μW (70.71 mV)	100.0 μW INDICATION
15	R543	DS ADJ	100 μW	10 μW (22.36 mV)	10.0 μW INDICATION
16	R520	FS RANGE ADJ	1 mW	1 mW (223.6 mV)	1.000 mW INDICATION
17	R548	DS ADJ	1 mW	100 μW (70.71 mV)	0.100 mW INDICATION
18	R519	FS RANGE ADJ	10 mW	10 mW (707.1 mV)	10.00 mW INDICATION
19	R562	DS ADJ	10 mW	1 mW (223.6 mV)	1.00 mW INDICATION
20	R624	dB RANGING ✱	10 mW 100 nW	10 mW (707.1 mV) 100 nW (2.236 mV)	ADJUST FOR 50 dB SPREAD BETWEEN 10 mW AND 100 nW.
21	R610	dB REFERENCE ✱	1 mW	1 mW (223.6 mV)	ADJUST FOR 0 dBm
22	R616	dB LINEARITY ✱	1 mW	1 mW (223.6 mV) 100 μW (70.71 mV)	ADJUST FOR 10.0 dB SPREAD BETWEEN 1 mW AND 100 μW.
23	R1408	−DPM FS ADJ	⊛	⊛	⊛
24	R573	CAL. FACTOR ADJ	⊛	READJUST IF CAL. FACTOR KNOB IS REMOVED FROM SHAFT.	

Figure 11.

5.4.3.1. Performance Check Procedure (dBm ranging)

a. Connect the instrument in a test set-up as shown in Figure 10. Depress the 10 mW button of the FULL SCALE range selector and inject an input of 707.1 mv.
b. Adjust the input to obtain a display indication of 10.00 mW. Set the OFF/PWR/dBm switch to dBm. Check for a display indication of 10.00 dBm.
c. Remove the instrument from the Figure 10 test set-up and connect it to a test set-up as shown in Figure 9. Depress the 100 nW button of the FULL SCALE range selector and set the OFF/PWR/dBm switch to PWR.
d. Inject an input of 2.236 mV and adjust the input for a display indication of 100 nW. Set the OFF/PWR/dBm switch to dBm and check for a display indication of -40.00 dBm.

5.4.3.2. Performance Check Procedure (dBm reference)

a. Connect the instrument to a test set-up as shown in Figure 9, depress the 1 mW button of the FULL SCALE range selector and inject an input of 223.6 mv (refer to Table 2, step 6).
b. Adjust input to obtain a display indication of 1.000 mW. Set the OFF/PWR/dBm switch to dBm and check for a display of .00 dBm.

5.4.3.3. Performance Check Procedure (dBm linearity)

a. Connect the instrument in a test set-up as shown in Figure 9. Depress the 1 mW button of the FULL SCALE range selector, and inject an input of 223.6 mV (refer to Table 2, step 6).
b. Adjust input to obtain a display indication of 1.000 mW. Set the OFF/PWR/dBm switch to dBm and record the reading displayed.
c. Decrease the input level to 70.71 mV and set the OFF/PWR/dBm switch to PWR. Adjust input level to obtain a display indication of .100 mW.
d. Set the OFF/PWR/dBym switch to dBm and adjust R616 on the digital control board (schematic D830592B) for a 10 dB spread between 1.000 mW and .100 mW.

5.5. **Calibration Procedures** (Schematics referred to are in the rear of the manual.)

If the performance checks of Paragraphs 5.4.1, 5.4.2 and 5.4.3 show a range or ranges outside of the specified tolerance, the following calibration procedures should be performed, using the same equipment and techniques as used in Paragraph 5.4.

The instrument should be calibrated at an ambient temperature of 68° to 720F (200 to 220C) after a minimum warmup time of ten minutes. The following adjustments, together with appropriate test points and adjustment location, are listed in abbreviated form on the inside surface of the instrument's top cover. A facsimile of this listing is illustrated in Figure 11, together with the location of applicable test points and adjustments.

Adjustment No. 1. Using dc meter No. 1, measure the -15.0 volt supply voltage at the -15 v test point located on the main amplifier board at C119.
If the voltage is not within tolerance (-15.0, ±0.1 vdc) adjust R143 to obtain the proper reading.

Adjustment No. 2. Using dc meter No. 1, measure the +15.0 volt supply voltage at the +15 v test point located on the main amplifier board at C118.
If the voltage is not within tolerance (+15.0, ±0.l vdc) adjust R140 to obtain the proper reading.

NOTE :

In the following adjustments, the voltages in parentheses apply to the Boonton Electronics Model 41-4C (75 ohm) Power Detector.

Adjustment No. 3. Depress the 1 4W button of the FULL SCALE range selector and apply 7.071 mV, ±0.2% (8.66 mV) (refer to Table 2, step 3). Using the frequency counter, measure the chopper frequency at test point 13 (the junction of R227 and C206 on the chopper driver board, schematic D830581C). The frequency counter should read 94 Hz, +1 Hz. If the frequency is not within tolerance, adjust R244 to obtain the desired reading. In some cases it may be desirable to offset the chopper frequency to avoid beating with a harmonic of the power line frequency. Any frequency within the adjustment range will not degrade the performance of the instrument.

Adjustment No. 4. Depress the 10 nW button of the FULL SCALE range selector and zero the instrument as described in Paragraph 3.2.1, step f.

Adjustment No. 5. Depress the 1 pW button of the FULL SCALE range selector. Using dc meter No. 2, measure the voltage of the RECORDER terminals on the rear panel of the Model 42BD. The voltage should be zero. If necessary, adjust R233 on the chopper driver board, schematic D830581, to obtain the required voltage.

Adjustment No. 6. Depress the 1 pW button of the FULL SCALE range selector and apply 7.071 mV, +0.2% (8.66 mV) input (refer to Table 2, step 3). Using dc meter No. 2 measure the voltage or test point 17 on the chopper driver board, schematic D830581. The voltage should be -3.00 volts. If necessary, remove the bottom cover and adjust R180 on the amplifier board, schematic E830592, to obtain the required voltage.

Adjustment No. 7. Depress the 1 pW button of the FULL SCALE range selector, and apply 7.071 mV, +0.2% (8.66 mV) input (refer to Table 2, step 3). Using dc meter No. 2, measure the voltage at the RECORDER terminals on the rear panel. The voltage should read +10.00 volts. If necessary, adjust R523 on the shaping amplifier board, schematic E830592, to obtain the required voltage.

Adjustment No. 8. Depress the 1 pW button of the FULL SCALE range selector and apply 7.071 mV, ±0.2% (8.77 mV) input refer to Table 2, step 3). The display indication should read 1.000 pW. If necessary, adjust R643 for 0. 500 Vdc at Pin 8 of IC605. Adjust R1405 for 1.OOOW indication.

Adjustment No. 9. Depress the 1 pW button of the FULL SCALE range selector and apply 7.071 mV, +0.2% (8.66 mV) input (refer to Table 2, step 3). The panel edgemeter should read 0 dBm. If necessary, adjust R639 on the digital control board, schematic D830592, to obtain the required reading.

Adjustment No. 10. (For instruments with Autorange option)

NOTE:
Normally this adjustment should not be required.

Depress the 1 4W button of the FULL SCALE range selector and apply 7.071 mV, +0.2% (8.66 mV) input (refer to Table 2, step 3). Depress the AUTO button of the FULL SCALE range selector, and increase the input level slowly, noting the point at which the instrument changes up to the 10 4W range. Refer to Paragraph 3.2.9 for over/under range indications. The range switching should occur when the display indication is 1.030 lW. If necessary, adjust R716 on the autorange board, schematic 830483, for a range trip at 1.030 uW by rotating R716 counterclockwise to decrease the trip point level and rotating R716 clockwise to increase the trip point level. It may be necessary to repeat the adjustment several times to reach the desired setting.

Adjustment No. 11. Depress the 10 nW button of the FULL SCALE range selector and zero the instrument as described in Paragraph 3.2.1, step f. Apply 0.707 mV, +0.2% (0.866 mV) input (refer to Table 2, step 1). The display should indicate 10.00 nW. If necessary, adjust R525 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 12. Depress the 100 nW button of the FULL SCALE range selector and zero the instrument as described in Paragraph 3.2.1, step f. Apply 2.236 mV, +0.2% (2.738 mV) input (refer to Table 2, step 2). The display should indicate 100.0 nW. If necessary, adjust R524 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 13. Depress the 10 uW button of the FULL SCALE range selector and apply 22.36 mV, +0.2% (27.38 mV) input (refer to Table 2, step 4). The display should indicate 10.00 uW. If necessary, adjust R522 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 14. Depress the 100 4W button of the FULL SCALE range selector and apply 70.71 mV, ±0.2% (86.6 mV) input (refer to Table 2, step 5). The display should indicate 100.0 uW. If necessary, adjust R521 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 15. Depress the 100 4W button of the FULL SCALE range selector and apply 22.36 mV, +0.2% (27.38 mV) input. The display should indicate 10.0 uW. If necessary, adjust R543 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 16. Depress the 1 mW button of the FULL SCALE range selector and apply 223.6 mV, ±0.2% (273.8 mV) input (refer to Table 2, step 6). The display should indicate 1.000 mW. If necessary, adjust R520 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 17. Depress the 1 mW button of the FULL SCALE range selector and apply 70.71 mV, +0.2% (86.6 mV) input. The display should indicate 0.100 mW. If necessary, adjust R548 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 18. Depress the 10 mW button of the FULL SCALE range selector and apply 707.1 mV, ±0.2% (866 mV) input (refer to Paragraph 5.4.2). The display should indicate 10.00 mW. If necessary, adjust R519 on the shaping amplifier board, schematic E830592, to obtain the proper indication.

Adjustment No. 19. Depress the 10 mW button of the FULL SCALE range selector and apply 223.6 mV, ±0.2% (273.8 mV) input. The display should indicate 1.00 mW. If necessary, adjust R562 on the shaping amplifier board, schematic E830592, to obtain the proper reading.

Adjustment No. 20. Depress the 1 mW button of the FULL SCALE range selector and set the OFF/PWR/dBm switch to dBm. Remove digital control board and mask pins 1, 2, Z and 22 with tape. Return the digital control board to the extender card. Inject -3.00 vdc, ±0.1% into the junction of R628 and R629, schematic D830592. If necessary, adjust R1408 on the digital panel meter board, schematic D830546, for a 6000 count indication. Remove -3.00 vdc from the junction and inject +10.00 vdc, ±0.1% into the junction of R631 and R638, schematic D830592. If necessary, adjust R1405 on the digital panel meter board, schematic D830546, for a display indication of 1.000 mW.

Adjustment No. 21. Set the OFF/PWR/dBm switch to dBm. Depress the +10 dBm button of the FULL SCALE range selector and adjust R610, schematic D830592, for a display of 10.00 dBm. Depress the -50 dBm button of the FULL SCALE range selector and adjust R624 for a display of -50.00 dBm. Repeat these steps to adjust for a 60 dB difference between +10 and -50 dB. Depress the 0 dBm button of the FULL SCALE range selector ai,d adjust R610 for a display of .00 dB. Check each range for the correct reading in dBm, ±0.1 dB; touch up R624 to bring in the middle ranges if they are not out by more than 0.2 dB. Depress the 0 dBm button of the FULL SCALE range selector and note the display. Decrease the injected 10.00 vdc to a value of +1.00 vdc, +0.1%. Note the display. Adjust R616 for a 10°dB difference between the readings. Remove voltage from the junction. Remove tape from the digital control board, remove extender card and insert the digital control board into the connector.

Adjustment No. 22. (Calibration Factor Adjustment)

NOTE :

This adjustment will be required only if the CAL FACTOR knob has been removed from its shaft, or if slippage of the knob on the shaft is suspected.

Center the CAL FACTOR control knob on the shaft so that the pointer swings an equal amount past the scale end points on each end of the rotation. Depress the 1 4W button of the FULL SCALE range selector, and set the CAL FACTOR control to -1 dBm. Using the ac source (Figure 9), adjust the input level until a display of 0.631 4W or -32.00 dBm is obtained. Rotate the CAL FACTOR control to the +1 dBm position and adjust R573 on the shaping amplifier board, schematic E830592, for a display of 1.000 4W or -30.00 dBm.

Adjustment No. 23.

NOTE :

This adjustment will be required only if IC1202 is replaced, and a 50 millisecond pulse is not obtained at pin 8 of IC1402.

Using an oscilloscope, measure the pulse width at pin 8 of IC1402, schematic D830546. The pulse should be 50 milliseconds wide. If necessary, adjust C1203, schematic D830546, to obtain the proper pulse width. If this pulse width cannot be obtained within the adjustment range of C1203, try slightly different values at C1202, up to 200 pfd, until the 50 millisecond pulse is within the range of trimmer C1203.

5.6. TROUBLESHOOTING PROCEDURE

If faulty operation of the Model 42BD is evident or if the preceding calibration procedures fail to correct an inaccurate reading, reference to Table 3, Troubleshooting, will assist in identifying the cause of the trouble and determining the corrective action to take. Often the nature of the difficulty itself will pinpoint the location of the trouble. If this is not the case, make a visual examination of the instrument by removing the top and bottom covers and inspecting for unseated printed circuit boards or connectors, loose components or fasteners, obviously defective components such as charred resistors, leaking capacitors, broken leads, or for foreign material. If this inspection fails to locate the trouble, it is recommended that the sequential steps of procedure specified in Table 3 be followed and that the schematic diagrams at the rear of the manual be referred to for assistance. It is recommended also that voltage measurements be made using a Fluke Model 8100A dc digital voltmeter, or equivalent. Use standard shop practices for isolating and replacing defective parts.

NOTE :

If it becomes necessary, during troubleshooting, to remove the CAL FACTOR control knob, first turn the control fully counterclockwise and mark the position of the knob pointer by a pencil scribe line on the front panel; then remove the knob. When replacing the knob, align the pointer with the scribe mark and secure the knob position. Check adjustment 24 after replacing the knob.

Table 3. Troubleshooting

Step	Trouble	Probable Cause	Corrective Action
1	INOPERATIVE INSTRUMENT	Faulty or incorrect line voltage	Correct line voltage or repair connection.
2	INOPERATIVE INSTRUMENT	Slide switch (rear panel) in incorrect position for applied line voltage	Set switch to proper position.
3	INOPERATIVE INSTRUMENT	Defective or incorrect fuse installation (rear panel)	Replace defective fuses or ensure installation of 0.2 A fuse for 115 volts; 0.1 A fuse for 230 volts.

Table 3. Troubleshooting (Continued)

Step	Trouble	Probable Cause	Corrective Action
4	INOPERATIVE INSTRUMENT	Defective power detector	Replace power detector and recalibrate instrument. NOTE: It is recommended that defective power detectors be returned to the factory for repair.(See 5.1
5	INOPERATIVE INSTRUMENT	No or incorrect negative voltage at test point at C119 on amplifier board (schematic E830592)	Adjust R143 to obtain -15.0, ±0.1 volt. If not attainable, check all components of -15 volt supply. Replace all defective parts.
6	INOPERATIVE INSTRUMENT	No or incorrect positive voltage at test point at C118 on amplifier board (schematic E830592)	Adjust R140 to obtain +15.0, ±0.1 volt. If not attainable, check all components of +15 volt supply. Replace all defective parts.
7	INSTRUMENT OPERATIVE BUT NO DISPLAY	No or incorrect voltage at test point between IC103 and IC106 on amplifier board (schematic E830592)	Replace IC103 to obtain +5.0, ±0.1 volt. If voltage still not attainable, check all components of +5 volt supply. Replace all defective parts.
8	INSTRUMENT OPERATIVE BUT NO DISPLAY	Defective or inoperative display lamps	Replace defective lamps and check connections. Check all components of digital panel meter display board (schematic D830546). Replace all defective parts.

Table 3. Troubleshooting (Continued)

Step	Trouble	Probable Cause	Corrective Action
9	INSTRUMENT OPERATIVE BUT INCOR-ECT OR ER-RATIC DIS-PLAY INDICATIONS	Defective or incorrect power detector	Check to ensure that the serial number of the power detector being used is the same as the serial number of the instrument or that the power detector is one to which the instrument has been calibrated. If power detector is defec-tive, replace and then recalibrate instrument. (Refer to step 4.)
10	INSTRUMENT OPERATIVE BUT INCOR-RECT OR ERRATIC DIS-PLAY INDI-CATIONS proceed with step 11.	Defective chopper G401	Replace defective chopper and recalibrate instru-ment. NOTE: If new chopper does not correct trouble, re-install old chopper and
11	INSTRUMENT OPERATIVE BUT INCOR-RECT OR ERRATIC DIS-PLAY INDI-CATIONS	Possible defective compo-nents and/or signal paths on amplifier board (sche-matic E830592)	Check waveshapes, voltages, and resistances at test TP1, TP2, TP3, and TP4. If readings are incorrect, check all components in signal paths and feedback circuits. Replace defec-tive parts. NOTE: FET Q109 is a fac-tory selected item and must be ordered from the factory.

Table 3. Troubleshooting (Continued)

12	INSTRUMENT OPERATIVE BUT INCORRECT OR ERRATIC DISPLAY INDICATIONS	Possible defective components and/or signal paths on printed circuit boards: - digital control (schematic D830592) - display panel meter analog/digital converter (schematic D830546) - digital panel meter counter board (schematic D830546) - digital panel meter display board (schematic D830546) - serial/parallel BCD converter (schematic D830650) - chopper driver (schematic D830581) - shaping amplifier (schematic E830592)	a. Inject a full scale input on any range and read the RECORDER voltage at P105 (rear panel). Voltage should read +10 volts. Lower input by a few dBm and note that RECORDER voltage follows input voltdge. If RECORDER voltage does not follow input voltage proceed to the following step b. If RECORDER voltage does follow input voltage, proceed as follows: Check waveshapes, voltages, and resistances on the following printed circuit boards in the sequence given: - digital control (D830592) - digital panel meter analog/digital converter (D830546 utilizing test points TP1 through TP7 - digital panel meter counter board (E830546) utilizing test points TP1 through TP3 - digital panel meter display board (D830546) - serial/parallel BCD converter (D830650)

Table 3. Troubleshooting (Continued)

12	INSTRUMENT OPERATIVE BUT INCORRECT OR ERRATIC DISPLAY INDICATIONS (cont.)		If readings are incorrect, check all components in signal paths and feedback circuits. Replace defective parts and repair or replace defective interconnections. b. If RECORDER voltage does not follow input voltage, proceed as follows: Check waveshapes, voltages, and resistances on the following printed circuit boards in the sequence given: - chopper driver (D830581) utilizing test points TP1 through TP17 - shaping amplifier (E830592) If readings are incorrect, check all components in signal paths and feedback circuits. Replace defective parts and repair or replace defective interconnections. If this procedure does not correct trouble, proceed with preceding step a.

Table 3. Troubleshooting (Continued)

Step	Trouble	Probable Cause	Corrective Action
13	INSTRUMENT OPERATIVE BUT DIGITAL DISPLAY DOES NOT BLANK OUT WHEN INPUT POWER IS ABOVE OR BELOW LIMITS FOR SELECTED RANGE	Possible defective components and/or signal path on amplifier board (schematic E830592) and shaping amplifier (schematic E830592)	Refer to Ranging Troubleshooting Chart, Figure
14	INSTRUMENT OPERATIVE WITH THE AUTO SWITCH ENGAGED BUT DIGITAL DISPLAY DOES NOT RANGE UP OR DOWN AS INPUT POWER IS VARIED	Possible defective components and/or signal path on amplifier board (schematic 830483)	Refer to Autoranging Troubleshooting Chart, Figure NOTE: This procedure applies only to Model 42BD equipped with the autoranging option.

5.7. POWER DETECTOR REPAIR

NOTE:

Repair and adjustment of a Power Detector is a difficult operation requiring a high degree of knowledge and skill. If the user elects to make such a repair, rather than to return the Detector to this factory, it must be understood that the repaired Detector may not meet the vswr and response characteristics as specified in this manual.

Before attempting a repair of the Power Detector, check all possible sources of trouble, such as the instrument itself, the probe cable, connectors, the RF power source, etc. If the defect cannot be located, and the symptoms indicate a faulty Power Detector, make the external resistance measurements outlined below to localize the trouble before opening the Detector housing. (A Simpson Model 260 is recommended for most of these measurements.)

a. Measure the resistance of the RF input connector from the center conductor to ground shell. This should be 50 1l ohms. (For this measurement, a more accurate instrument than the Model 260 must be used.)

b. Inspect the rear connector for possible damage. Measure the resistance from pins 1 and 2 to ground. This should measure > 10 MQ.

c. With the Model 260 on the 10 kE range, measure the resistance from pin 1 (negative lead of the 260) to pin 2 (positive lead). This should be 20 to 30 kQ.

d. With the Model 260 on the 10 kh range, measure the resistance from pin 1 (positive lead of the 260) to pin 2 (negative lead). This should be > 400 kQ.

After completing the resistance measurements, the Power Detector housing may be opened as follows:

e. Remove the three 2-56 screws holding the outer shield. Slide the shield forward over the RF input connector.

f. Look for broken wires at this point. If any are found, repair them and retest the unit before proceeding.

g. The rear connector may now be replaced, if necessary, by removing the set-screw at the side of the rear disc (the red mark on the side of the housing polarizes pin 1).

h. Remove the four 2-56 screws holding the inner shield. Slide the shield backwards from the main housing. Unsolder the wires at the teflon terminals, if necessary.

If the Power Detector failed the insulation test in (b), look for a short to ground from the 1000 pF capacitors C102 and C103, or an internal short in one of the capacitors. These capacitors may be removed by taking out the two 0-80 screws on the side of the bracket. Tilt the housing to the side so the bracket will fall away when a soldering iron is touched to the joint. The capacitor may then easily be replaced remotely from the housing. Screw the bracket to the housing before soldering.

CAUTION:

Always ground the soldering iron tip when soldering the probe housing to avoid damaging the diodes.

If the Power Detector failed the tests of (c) or (d), measure the resistance of the diodes CR101 and CR102 with the Model 260 on the 10 kn range. The forward resistance of each diode should measure about 500 ohms, and the backw;rd resistance should be greater than 50 kh. If the back resistance of a diode measures appreciably less than 50 ka, replace it, using the following technique:

i. While grasping the diode with tweezers, and applying a light upward pull, touch the center post with a small, high-temperature iron. The diode will lift when the solder melts. Now unsolder the far end of the series resistor and lift out the diode-resistor combination.

j. At this point, test the terminating resistors as in (a). If R101 or R102 tests faulty, replace it as follows: Remove the four 2-56 screws holding the 100 Q resistors in place. Unsolder from the center post by pulling the resistor from the rear while heating the center post. (Overheating can cause distortion of the teflon spacer supporting the center conductor.) Replace the new resistor in the reverse order.

k. After any critical parts (diodes or terminating resistors) have been replaced, it will be necessary to check the input vswr throughout the specified frequency range. The test may be made with the shields off the make adjustment easier. The vswr may be checked by any convenient means, such as slotted line, reflectometer, etc. Adjust the length of the 100 A resistor leads with the clamps on the top of the housing. In general, longer lead lengths will increase the vswr at 6 and 7 GHz, and will decrease it at 11 and 12 GHz. It will usually be necessary to compromise somewhat in these adjustments and try to find the optimum setting across the range.

Variations in the high-frequency response after repair are covered by the Calibration Factor and Effective Efficiency section of this manual, found in Paragraph 3.2.5.1.

If proper adjustment of the Power Detector after repair is found difficult, return it to the factory. In a covering letter, be sure to include details of all work performed on the Detector and parts replaced. This information will help our repair department to return the Detector to you in the shortest possible time.

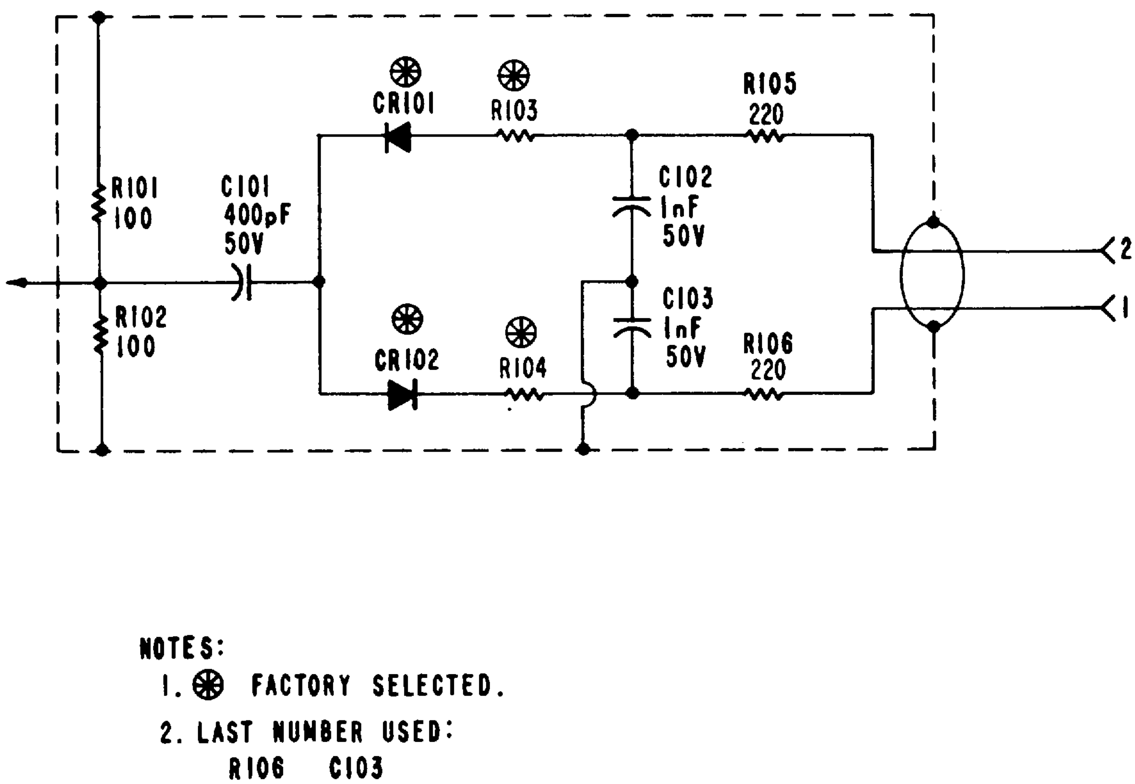


Figure 12. Power Detector

CHAPTER VI
INTERFACE INFORMATION

6.1. PROGRAMMING INPUTS

Pin No.	Function	Comment	Command	Unit Loading
7	Man. Disable	Disables front panel range selection	0	0.1
8	dBm enable	Selects dBm display*	0	0.1
6	Auto enable	Selects automatic ranging*	0	0.1
16	10 nW range	Selects range provided manual disable has	0	0.1
15	100 nW	also been selected, and autorange has not	0	0.1
14	1 bW	"been selected; selecting more than one	0	0.1
13	10 bW	"range will result in incorrect indications.	0	0.1
12	100 lW	"Range lines must be deselected for either	0	0.1
11	1 mW	"manual or auto ranging.	0	0.1
10	10 mW		"0	0.1
X	Encode hold	Holds display	0	0.2
V	Encode trigger	Starts encode cycle	(See 6.1.3)	0.1

***Assumes that Man. Disable has also been selected**

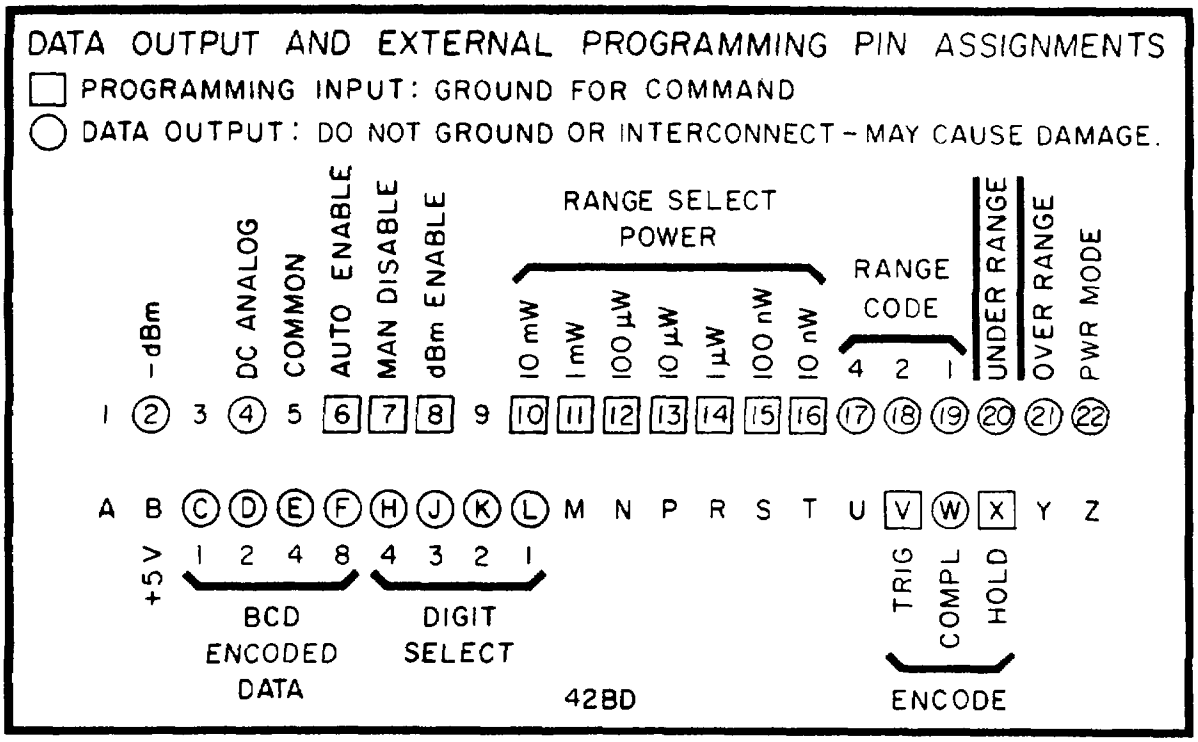


Figure 13. External Connections

6.1.1 Input Characteristics

TTL Series	Logic Level	Voltage Level	Current per Unit Load
	0	<0.7 V	-1.6 mA*
Standard Power 54/74	1	2.4 to 5.25 V	40 pA

*The -current indicates current out of the input (external command device must sink this current). A standard power (Series 54/74) TTL output will sink and source 10 unit loads.

6.1.2 Input Pull-Up

All input terminals have internal pull-up. The current sourced by this pull-up when the input is brought to a logic level 0 is included in the loading shown in the "Unit Loading" column of the chart in 6.1.

6.1.3 Triggering

To trigger an encode cycle, the trigger line must be transferred from logic "1" to logic "0". Limits for trigger pulse characteristics are shown in 6.3.1.

6.2 DATA OUTPUTS

Pin No.	Function	Comment	True Logic Level	54/74 Unit Load
22	mW Mode	Indicates power display	1	1
4	DC Analog	10 V for full scale	n/a	n/a
21	Overrange	Indicates that instrument range should be increased	0	1
20	Underrange	Indicates that instrument range should be decreased	0	1
2	-dBm	Indicates that dBm is below ref. level	1	1
W complete	Encode may be read	Indicates completion of encode cycle; data output	1	1
17	4	Indicates range selected in binary code; 0 = 10 nW range, 6 = 10 mW	1	1
18	2 range			
19	1			
F	8		1	1
E	4 BCD	Data in serial form, continuously scanned left	1	1
D	2 enc.	(MSD) to right, 500 s/digit, 2 ms	1	1
C	1		1	1
H	4		1	1
J	3 Digit	Indicates digit to which BCD data applies;	1	1
K	2 Select	4 = MSD (left-most)	1	1
L	1		1	1

6.2.1 Output Characteristics

TTL Series	Logic Level	Voltage Level	Current per Unit Load
Standard Power 54/74	0	(0.7 V	1.6 mA*
	1	2.4 50 5.25 V	-40 pA

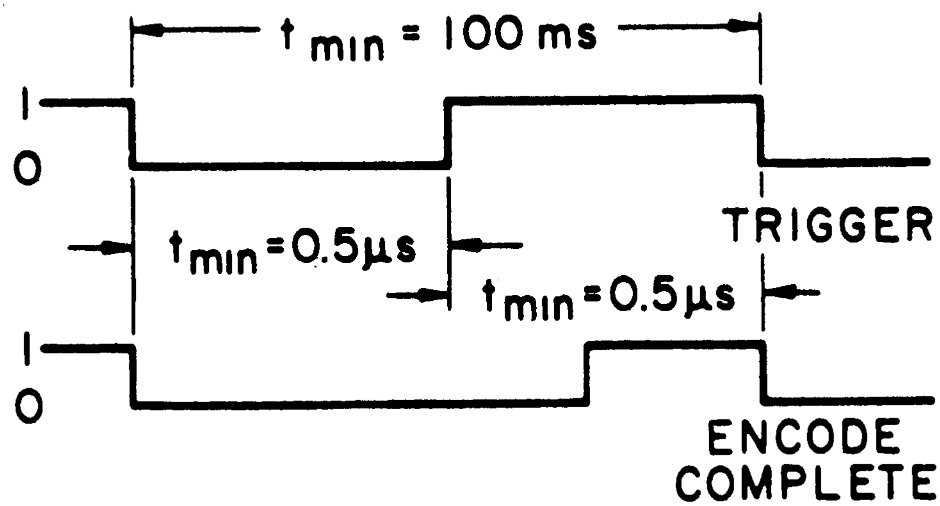
*The - current indicates current sourced by output.

6.2.2 Analog Output

Source resistance is 9 kn.

6.3 WAVEFORMS

6.3.1 Encode Trigger



6.3.2 Data Output Timing

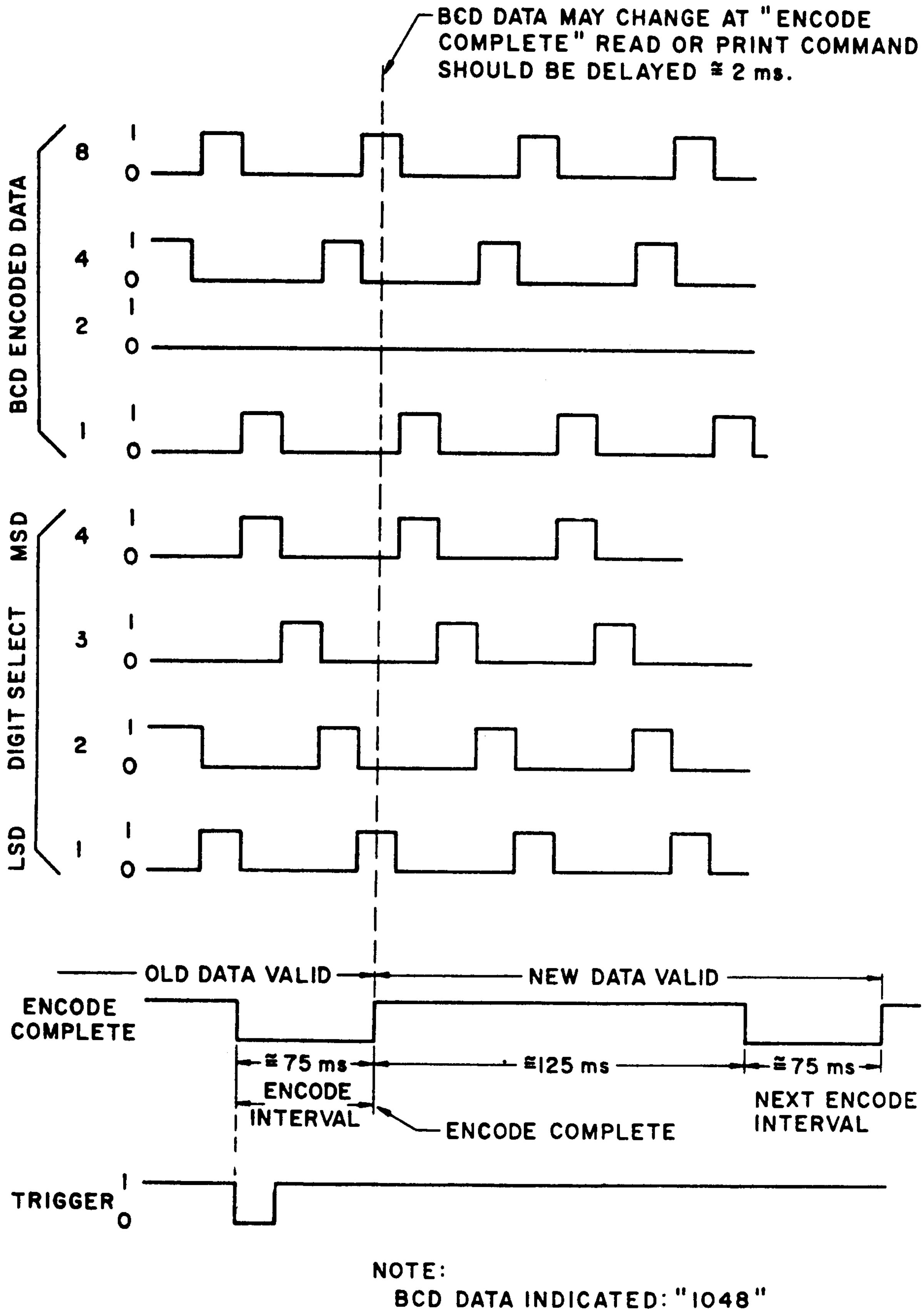


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TABLE OF REPLACEABLE PARTS

Reference	**Description**		**BEC Part No.**
		AMPLIFIER P. C. BOARD	
C101	Capacitor, PE	100 nF ± 10% 200 V	234005
C102	Capacitor, Elec.	10 pF ± 20% 20 V	283205
C103	Capacitor, Mica	100 pF ± 5% 500 V	200001
C104	Capacitor, Elec.	10 pF ± 20% 20 V	283205
C105	Capacitor, Elec.	33 pF ± 20% 15 V	283206
C106	Capacitor, Elec.	10 pF ± 20% 20 V	283205
C107	Capacitor, Met.	1.0 pF ± 20% 100 V	236007
C108	Capacitor, Elec.	1.0 pF ± 20% 35 V	283199
C109	Capacitor, Elec.	50 pF ± 75 /-10% 25 V	283159
C110	Capacitor, Elec.	50 pF ± 75 /-10% 25 V	283159
C111	Capacitor, PE	100 nF ± 10% 200 V	234005
C112	Capacitor, Elec.	250 pF 40 V	283207
C113	Capacitor, Elec.	250 pF 40 V	283207
C114	Capacitor, Elec.	1000 pF -10% + 150% 15 V	283221
C115	Capacitor, Cer.	100 nF + 80% -20% 25 V	224124
C116	Capacitor, Cer.	100 nF + 80% -20% 25 V	224124
C117	Capacitor, Elec.	10 pF ± 20% 20 V	283205
C118	Capacitor, Elec.	100 pF + 75/-10% 25 V	283105
C119	Capacitor, Elec.	100 pF + 75/-10% 25 V	283105
CR101	Diode, Sig.	FD300	530052
CR102	Diode, Sig.	1 N914	530058
CR103	Diode, Sig.	1 N914	530058
CR104	Diode, Zener	1 N5243B (13 V)	530101
CR105	Diode, Zener	1 N5235B (6.8 V)	530089
CR106 through CR110	Diode, Sig.	1 N914	530058
CR111	Bridge, Rectifier	KBP-02	532013
CR112	Bridge, Rectifier	KBP-02	532013
CR113	Bridge, Rectifier	KBP-02	532013
CR114	Diode, Sig.	1N914	530058
CR115	Diode, Sig.	1N914	530058
CR116	Diode, Sig.	1N914	530058
CR117	Not Used		
CR118 through CR125	Diode, Sig.	1 N914	530058
IC101	Integrated Circuit	pA7805 Regulator	535011
IC102	Integrated Circuit	pA7805 Regulator	535011
IC103	Integrated Circuit	pA7805 Regulator	535011
IC104	Integrated Circuit	MFC6030A Regulator	535007
IC105	Integrated Circuit	MFC6030A Regulator	535007
IC106	Integrated Circuit	SN74LOON Quad 2 Input NAND Gate	534002
J101	Receptacle	Amphenol 143-022-03 (22 Pins)	479231
J102	Receptacle	Amphenol 143-022-03 (22 Pins)	479231
J103	Receptacle	Amphenol 143-022-03 (22 Pins)	479231
J104	Receptacle	Amphenol 225-22221-103 (Dual 22 Pins)	479254
J1201	Receptacle	Amphenol 225-22221-101 (Dual 22 Pins)	479259
Q101	Transistor, FET	2 N5949	528019
Q102	Not Used		

AMPLIFIER P. C. BOARD (CONTINUED)

Reference	Description		BEC Part No.
Q103	Transistor, FET	HDGP1000	528066
Q104	Transistor, FET	2N5949	528019
Q105	Transistor, FET	TIS58	528038
Q106	Transistor, FET	HDGP1001	528057
Q107	Transistor, FET	HDGP1000	528066
Q108	Transistor, FET	2N5949	528019
Q109	Transistor, FET	Selected	528044
Q110	Transistor, NPN	2N5088	528047
Q111	Transistor, PNP	2N5087	528042
Q112	Transistor, PNP	MPSA66	528048
Q113	Transistor, PNP	2N5087	528042
Q114	Transistor, NPN	2N5088	528047
Q115	Transistor, FET	TIS58	528038
Q116	Transistor, FET	TIS58	528038
Q117	Transistor, FET	TIS58	528038
Q118	Transistor, FET	2N5949	528019
Q119	Transistor, FET	2N5949	528019
Q120	Transistor, FET	2N5949	528019
Q121	Transistor, PNP	MPSA66	528048
Q122	Transistor, PNP	MPS6516	528037
Q123	Transistor, PNP	MPS6516	528037
Q124	Not Used		
Q125 through Q132	Transistor, PNP	MPS6516	528037
R101	Resistor, Comp.	1MΩ5%	344600
R102	Resistor, Comp.	3.9 kΩ 5%	343357
R103	Resistor, Comp.	3.9 kΩ 5%	343357
R104	Resistor, MF	5.62 MΩ 1% 1/4 W	325397
R105	Not Used		
R106	Resistor, MF	52.3 kΩ 1%	341469
R107	Resistor, MF	232 kΩ 1%	341535
R108	Resistor, MF	1.0 MΩ 1%	342600
R109	Not Used		
R110	Resistor, Comp.	91 kΩ 5%	344492
R111	Resistor, Comp.	47 kΩ 5%	344465
R112	Resistor, Comp.	33 kΩ 5%	344450
R113	Resistor, Comp.	300 kΩ 5%	344546
R114	Resistor, MF	121 Ω 1%	341208
R115	Resistor, Camp.	10 k Ω°%	344400
R116	Resistor, Comp.	10 k Ω 5%	344400
R117	Resistor, Comp.	33 k Ω 5%	344450
R118	Resistor, MF	15.0 kΩ 1%	341417
R119	Resistor, Comp.	15 kΩ 5%	344417
R120	Resistor, Comp.	3.6 kΩ 5%	344353
R121	Resistor, Comp.	3 kΩ 5%	344346
R122	Resistor, Comp.	1 MΩ 5%	344600
R123	Resistor, Comp.	2.7 kΩ 5%	344341
R124	Resistor, Comp.	5.6 kΩ 5%	344372
R125	Resistor, Comp.	5.6 kΩ 5%	344372
R126	Resistor, Comp.	1 kΩ 5%	344300
R127	Resistor, Comp.	5.1 kΩ 5%	344368
R128	Resistor, Comp.	15 kΩ 5%	344417
R129	Resistor, Comp.	1 kΩ 5%	344300
R130	Resistor, Comp.	10 kΩ 5%	344400
R131	Resistor, MF	30.1 kΩ 1%	341446
R132	Resistor, MF	3.01 kΩ 1%	341346

Reference	Description		BEC Part No.

AMPLIFIER P. C. BOARD (CONTINUED)

R133	Resistor, MF	301 Ω 1%	341246
R134	Resistor, MF	34.8 Ω 1%	341152
R135	Resistor, Comp.	1 MΩ 5%	344600
R136	Resistor, Comp.	1 kΩ 5%	344600
R137	Resistor, Comp.	1 kΩ 5%	344300
R138	Resistor, Comp.	15 kΩ 5%	344417
R139	Resistor, MF	1.62 kΩ 1%	341320
R140	Resistor, Var.	200 Ω ± 10% 1/2 W	311304
R141	Resistor, MF	604 Ω 1%	341275
R142	Resistor, MF	1.62 kΩ 1%	341320
R143	Resistor, Var.	200 Ω +10% 1/2 W	311304
R144	Resistor, MF	604 Ω 1%	341275
R145	Resistor, MF	9.09 kΩ 1%	341392
R146	Resistor, Comp.	160 kΩ 5%	343520
R147	Resistor, Comp.	39 kΩ 5%	343457
R148	Resistor, Comp.	100 kΩ 5%	343500
R149	Resistor, Comp.	160 kΩ 5%	343520
R150	Resistor, Comp.	39 kΩ 5%	343457
R151	Resistor, Comp.	100 kΩ 5%	343500
R152	Resistor, Comp.	160 kΩ 5%	343520
R153	Resistor, Comp.	39 kΩ 5%	343457
R154	Resistor, Comp.	100 kΩ 5%	343500
R155	Not Used		
R156	Not Used		
R157	Not Used		
R158	Resistor, Comp.	160 kΩ 5%	343520
R159	Resistor, Comp.	39 kΩ 5%	343457
R160	Resistor, Comp.	100 kΩ 5%	343500
R161	Resistor, Comp.	160 kΩ 5%	343520
R162	Resistor, Comp.	39 kΩ 5%	343457
R163	Resistor, Comp.	100 kΩ 5%	343500
R164	Resistor, Comp.	160 kΩ 5%	343520
R165	Resistor, Comp.	39 kΩ 5%	343457
R166	Resistor, Comp.	100 kΩ 5%	343500
R167	Resistor, Comp.	160 kΩ 5%	343520
R168	Resistor, Comp.	39 kΩ 5%	343457
R169	Resistor, Comp.	100 kΩ 5%	343500
R170	Resistor, Comp.	160 kΩ 5%	343520
R171	Resistor, Comp.	39 kΩ 5%	343457
R172	Resistor, Comp.	100 kΩ 5%	343500
R173	Resistor, Comp.	160 kΩ 5%	343520
R174	Resistor, Comp.	39 kΩ 5%	343457
R175	Resistor, Comp.	100 kΩ 5%	343500
R176	Resistor, Comp.	160 kΩ 5%	343520
R177	Resistor, Comp.	39 kΩ 5%	343457
R178	Resistor, Comp.	100 kΩ 5%	343500
R179	Resistor, MF	150 Ω 1%	341217
R180	Resistor, Var.	100 Ω ± 20%	311277

CHOPPER DRIVER P. C. BOARD

A201	Op. Amp. LM302H	LM302H	535003
C201	Capacitor, PC	100 nF ± 10% 50 V	234046
C202	Capacitor, PE	6.8 nF ± 10% 200 V	234044
C203	Capacitor, Mica	100 pF ± 5% 500 V	200001
C204	Capacitor, Mica	100 pF ± 5% 500 V	200001
C205	Capacitor, PE	22 nF ± 10% 200 V	230101

Reference	Description		BEC Part No.
	CHOPPER DRIVE P. C. BOARD (CONTINUED)		
C206	Capacitor, PC	100 nF ± 10% 50 V	234046
C207	Capacitor, Mica	100 pF ± 5% 500 V	200001
C208	Capacitor, PC	100 nF ± 10% 50 V	234046
C209	Capacitor, Cer.	10 nF 100 V	224119
C210	Capacitor, Cer.	10 nF 100 V	224119
C211	Capacitor, PE	22 nF ± 10% 200 V	230101
C212	Capacitor, PC	470 nF ±10% 80 V	234128
C213	Capacitor, Mica	100 pF ± 5% 500 V	200001
C214	Capacitor, Elec.	50 pF ± 75/-10% 25 V	283159
C215	Capacitor, Elec.	50 pF ± 75/-10% 25 V	283159
C216	Capacitor, Elec.	50 pF ± 75/-10% 25 V	283159
C217	Capacitor, Elec.	150 pF ± 75/-10% 15 V	283307
CR201 through CR218	Diode, Sig.	1N914	530058
CR219	Diode, Sig.	FD-300	530052
Q201	Transistor, Unijunction	2N4871	528051
Q202	Transistor, NPN	MPS-A20	528043
Q203	Transistor, PNP	2N5087	528042
Q204	Transistor, NPN	2N5088	528047
Q205	Transistor, NPN	MPS-A20	528043
Q206	Transistor, FET	MPS-A12	528052
Q207	Transistor, NPN	MPS-A20	528043
Q208	Transistor, FET	Selected	528093
Q209	Transistor, NPN	MPS-A20	528043
Q210	Transistor, FET	Selected	528093
Q211	Transistor, F ET	2N5949	528019
Q212	Transistor, NPN	MPS-A20	528043
Q213	Transistor, NPN	2 N5308	528050
Q214	Transistor, NPN	2 N5308	528050
R201	Resistor, Comp.	10 kΩ 5%	344400
R202	Resistor, Comp.	22 kΩ 5%	344433
R203	Resistor, Comp.	10 kΩ 5%	344400
R204	Resistor, Comp.	100 Ω 5%	344200
R205	Resistor, Comp.	33 kΩ 5%	344450
R206	Resistor, Comp.	10 kΩ 5%	344400
R207	Resistor, Comp.	100 kΩ 5%	344500
R208	Resistor, Comp.	3.3 kΩ 5%	344350
R209	Resistor, Comp.	4.7 kΩ 5%	344365
R210	Resistor, Comp.	10 kΩ 5%	344400
R211	Resistor, Comp.	150 kΩ 5%	344517
R212	Resistor, Comp.	10 kΩ 5%	344400
R213	Resistor, Comp.	10 kΩ 5%	344400
R214	Resistor, Comp.	22 kΩ 5%	344433
R215	Resistor, Comp.	10 kΩ 5%	344400
R216	Resistor, Comp.	270 kΩ 5%	344541
R217	Resistor, Comp.	240 kΩ 5%	344537
R218	Resistor, Comp.	10 kΩ 5%	344400
R219	Resistor, Comp.	15 kΩ 5%	344417
R220	Resistor, Comp.	10 kΩ 5%	344400
R221	Resistor, Comp.	10 kQ 5%	344400
R222	Resistor, Comp.	10 kΩ 5%	344400
R223	Resistor, Comp.	4.7 kΩ 5%	344365
R224	Resistor, Comp.	12 kΩ 5%	344408
R225	Resistor, Comp.	100 kΩ 5%	344500

Reference	Description		BEC Part No.
	CHOPPER DRIVE P. C. BOARD (CONTINUED)		
R226	Resistor, Comp.	100 kΩ 5%	344500
R227	Resistor, Comp.	15 kΩ 5%	344417
R228	Resistor, Comp.	10 kΩ 5%	344400
R229	Resistor, Comp.	100 kΩ 5%	344500
R230	Resistor, Comp.	12 kΩ 5%	344408
R231	Resistor, Comp.	4.7 kΩ 5%	344365
R232	Resistor, Comp.	100 kΩ 5%	344500
R233	Resistor, Var.	2 kΩ 20% 1/2 W	311285
R234	Resistor, Comp.	100 kΩ 5%	344500
R235	Resistor, Comp.	100 kΩ 5%	344500
R236	Resistor, Comp.	27 kΩ 5%	344441
R237	Resistor, Comp.	100 kΩ 5%	344500
R238	Resistor, Comp.	100 kΩ 5%	344500
R239	Resistor, Comp.	1.6 kΩ 5%	344320
R240	Resistor, Comp.	300 Ω 5%	344246
R241	Resistor, Comp.	62 Ω 5% 1 W	302072
R242	Resistor, Comp.	150 kΩ 5%	344517
R243	Resistor, Comp.	510 kΩ 5%	344568
R244	Resistor, Var.	50 kΩ 20% 1/2 W	311282
R245	Resistor, Comp.	47 Ω 5%	344165
	CHOPPER SOCKET		
C401	Capacitor, Mylar	100 nF 10% 50 V	234046
C402	Capacitor, Mylar	100 nF 10% 50 V	234046
	SUB PANEL		
G401	Chopper	Special	540126
J401	Receptacle	Amphenol 80-PC-2FT	479119
M401	Meter & Scale	API	554287
R401	Resistor, Var.	5 kΩ 10% 1 W	311345
R402	Resistor, Var.	5 kΩ ± 10%/o 2 W	311265
S401	Switch, Pushbutton	Centralab	465154
S403	Switch, Rotary	Ledex	466226
	REAR PANEL		
F401	Fuse, Slo-Blo	1/10 A 250 V	545519
F401	Fuse	2/10 A 250 V	545508
S402	Switch, Slide	Switchcraft	465134
T401	Power Transformer	Boonton Electronics	446066
	SHAPING AMPLIFIER		
A501	Op. Amp.	LM301AN	535012
A502	Op. Amp.	LM301AN	535012
A503	Op. Amp.	LM310	535005
C501	Capacitor, Cer.	10 nF 100 V	224119
C502	Capacitor, Cer.	33 pF 5% 500 V	224139

Reference	Description		BEC Part No.
	SHAPING AMPLIFIER (CONTINUED)		
C503	Capacitor, Cer.	10 nF 100 V	224119
C504	Capacitor, Cer.	10 nF 100 V	224119
C505	Capacitor, Cer.	33 pF 5% 500 V	224139
C506	Capacitor, Cer.	10 nF 100 V	224119
CR501 through CR510	Diode, Sig.	1N914	530058
Q501	Transistor, NPN	2N5088	528047
Q502	Transistor, NPN	2N5088	528047
Q503 through Q509	Transistor, FET	2N5949	528019
Q510 through Q513	Transistor, NPN	2N5088	528047
Q514	Transistor, FET	Selected	528068
Q515	Transistor, NPN	2N5088	528047
Q516	Transistor, FET	Selected	528068
Q517	Transistor, NPN	2N5088	528047
Q518	Transistor, FET	Selected	528068
Q519	Transistor, NPN	2N5088	528047
Q520	Transistor, FET	Selected	528068
Q521 through Q525	Transistor, NPN	2N5088	528047
Q526	Transistor, FET	Selected	528068
Q527 through Q532	Transistor, NPN	2N5088	528047
Q533	Transistor, FET	2N5949	528019
Q534	Transistor, FET	2N5949	528019
R501 through R507	Resistor, Comp.	4.7 MΩ 5%	344665
R508	Resistor, MF	8.66 kΩ 1%	341390
R509	Resistor, MF	8.66 kΩ 1%	341390
R510	Resistor, MF	9.53 kΩ 1%	341394
R511	Resistor, MF	165 kΩ 1%	341521
R512	Resistor, MF	866 kΩ 1%	342590
R513	Resistor, MF	499 kΩ 1%	341567
R514	Resistor, MF	49.9 kΩ 1%	341467
R515	Resistor, MF	4.99 kΩ 1%	341367
R516	Resistor, MF	210 kΩ 1%	341531
R517	Resistor, MF	536 kΩ 1%	342570
R518	Resistor, MF	13.0 kΩ 19%	341411
R519 through R522	Resistor, Var.	2 kΩ 10% 1 W	311264
R523	Resistor, Var.	1 kΩ 20% 1 W	311256
R524	Resistor, Var.	1 kΩ 20% 1 W	311256
R525	Resistor, Var.	2 kΩ 10% 1 W	311264
R526	Resistor, MF	2.74 kΩ 1%	341342
R527	Resistor, MF	3.57 kΩ 1%	341353
R528	Resistor, MF	3.92 kΩ 1%	341357
R529	Resistor, MF	4.75 kΩ 1%	341365

Reference	**Description**		**BEC Part No.**
		SHAPING AMPLIFIER (CONTINUED)	
R530	Resistor, Comp.	180 Ω 5%	344225
R531	Resistor, MF	84.5 kΩ 1%	341489
R532	Resistor, MF	787 kΩ 1%	342586
R533	Resistor, MF	78.7 kΩ 1%	341486
R534	Resistor, MF	392 kΩ 1%	341557
R535	Resistor, Comp.	1 MΩ 5%	344600
R536	Resistor, MF	143 kΩ 1%	341515
R537	Resistor, MF	536 kΩ 1%	342570
R538	Resistor, MF	54.9 kΩ 1%	341471
R539	Resistor, MF	154 kΩ 1%	341518
R540	Resistor, Comp.	1 MΩ 5%	344600
R541	Resistor, MF	90.9 kΩ 1%	341492
R542	Resistor, MF	210 kΩ 1%	341531
R543	Resistor, Var.	20 kΩ 10% 1 W	311266
R544	Resistor, MF	21.0 kΩ 1%	341431
R545	Resistor, Comp.	1 MΩ 5%	344600
R546	Resistor, MF	38.3 kΩ 1%	341456
R547	Resistor, MF	274 kΩ 1%	341542
R548	Resistor, Var.	20 kΩ 10% 1 W	311266
R549	Resistor, MF	48.7 kΩ 1%	341466
R550	Resistor, MF	226 kΩ 1%	341534
R551	Resistor, MF	35.7 kΩ 1%	341453
R552	Resistor, MF	118 kΩ 1%	341507
R553	Resistor, MF	45.3 kΩ 1%	341463
R554	Resistor, MF	110 kΩ 1%	341504
R555	Resistor, MF	36.5 kΩ 1%	341454
R556	Resistor, MF	73.2 kΩ 1%	341483
R557	Resistor, MF	25.5 kΩ 1%	341439
R558	Resistor, Comp.	1 MΩ 5%	344600
R559	Resistor, Comp.	10 kΩ 5%	344400
R560	Resistor, MF	26.7 kΩ 1%	341441
R561	Resistor, MF	158 kΩ 1%	341519
R562	Resistor, Var.	20 kΩ 10% 1 W	311266
R563	Resistor, Comp.	5.1 kΩ 5%	344368
R564	Resistor, Comp.	5.1 kΩ 5%	344368
R565	Resistor, MF	39.2 kΩ 1%	341457
R566	Resistor, MF	169 kΩ 1%	341522
R567	Resistor, MF	7.87 kΩ 1%	341386
R568	Resistor, MF	32.4 kΩ 1%	341449
R569	Resistor, MF	97.6 kΩ 1%	341495
R570	Resistor, MF	40.2 kΩ 1%	341458
R571	Resistor, MF	100 kΩ 1%	341500
R572	Resistor, Comp.	7.5 kΩ 5%	344384
R573	Resistor, Var.	2 kΩ 20% 1/2 W	311285
R574	Resistor, MF	27.4 kΩ 1%	341442
R575	Resistor, MF	56.2 kΩ 1%	341472
R576	Resistor, Comp.	5.1 kΩ 5%	343368
R577	Resistor, Comp.	5.1 kΩ 5%	343368
R578	Resistor, MF	2.37 kΩ 1%	341336
RT501	Thermistor	100 Ω ± 10%	325005
		DIGITAL CONTROL BOARD	
A604	Op. Amp.	LM301AN	535012
A605	Op. Amp.	LM301AN	535012
C606	Capacitor, Cer.	10 nF 100 V	224119

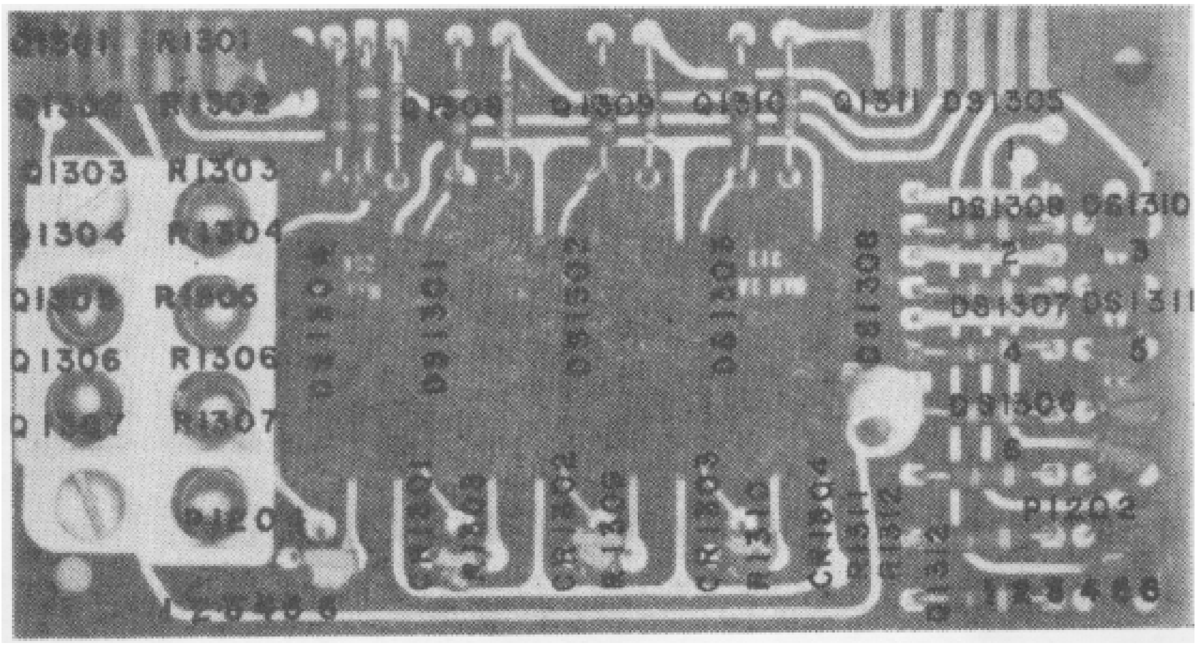
Reference	Description	BEC Part No.	
	DIGITAL CONTROL BOARD (CONTINUED)		
C607	Capacitor, Cer.	10 nF 100 V	224119
CR601	Diode, Zener	1 N5236B (7.5 V)	530087
CR603	Diode, Zener	1 N5227B (3.6 V)	530095
CR604	Diode, Zener	1 N5227B (3.6 V)	530095
IC601	Integrated Circuit	SN7409N Quad 2 Input AND Gate	534043
IC602	Integrated Circuit	CD4025AE Triple 3 Input NOR Gate	534065
IC603	Integrated Circuit	SN74L42N Decoder Driver	534064
IC604	Integrated Circuit	SN74L10N Triple 3 Input NAND Gate	534029
IC605	Integrated Circuit	CD4016AE Quad Switch	534007
IC606	Integrated Circuit	SN74L00N Quad 2 Input NAND Gate	534002
Q602	Transistor, F ET	2N5653	528056
Q604	Transistor, FET	2N5653	528056
Q606	Transistor, FET	2N5653	528056
Q607	Transistor, PNP	2N3905	528025
Q608	Transistor, FET	2N5653	528056
Q609	Transistor, PNP	2N3905	528025
R602	Resistor, Comp.	4.7 kΩ 5%	344365
R604	Resistor, Comp.	4.7 kΩ 5%	344365
R606	Resistor, Comp.	4.7 kΩ 5%	344365
R607	Resistor, Comp.	4.7 kΩ 5%	344365
R608	Resistor, Comp.	100 kΩ 5%	344500
R609	Resistor, Comp.	15 kΩ 5%	344417
R614	Resistor, Comp.	100 kΩ 5%	344500
R615	Resistor, Comp.	100 kΩ 5%	344500
R619	Resistor, Comp.	100 kΩ 5%	344500
R620	Resistor, Comp.	10 kΩ 5%	344400
R621	Resistor, Comp.	4.7 kΩ 5%	344365
R626	Resistor, MF	953 Ω 1%	341294
R631	Resistor, MF	19.1 kΩ 1%	341427
R632	Resistor, MF	13.0 kΩ 1%	341411
R633	Resistor, MF	4.75 kΩ 1%	341365
R634	Resistor, Comp.	10 kΩ 5%	344400
R635	Resistor, MF	33.2 kΩ 1%	341450
R636	Resistor, MF	76.8 kΩ 1%	341485
R637	Resistor, Comp.	10 kΩ 5%	344400
R638	Resistor, MF	9.76 kΩ 1%	341395
R639	Resistor, Var.	2 kΩ 10% 1 W	311264
R643	Resistor, Var.	100 Ω 10% 1 W	311383
	COUNTER P. C. BOARD		
C1201	Capacitor, Elec.	200 pF +75/-10% 6 V	283147
C1202 *	Capacitor, Mica	120pF 5% 500 V	200002
C1202*	Capacitor, Mica	56 pF 5% 500 V	200030
C1202*	Capacitor, Mica	150 pF 5% 500 V	200032
C1202*	Capacitor, Mica	91 pF 5% 500 V	200035
C1202*	Capacitor, Mica	33 pF 5% 500 V	200049
	*One of the above to be selected during calibration		
C1203	Capacitor, Var.	4.5 - 50 pF 250 V	281009
C1204	Capacitor, Mica	33 pF 5% 500 V	200049
C1205	Capacitor, Mylar	10 nF 20% 250 V	234085
C1206	Capacitor, Mylar	100 nF 20% 250 V	234080
C1207	Capacitor, Cer.	33 pF 10% 100 V	224218

Reference	Description		BEC Part No.
	COUNTER P. C. BOARD (CONTINUED)		
C1208	Capacitor, Elec.	10 µF 20% 20 V	283205
C1209	Capacitor, Elec.	10 µF 20/o 20 V	283205
CR1201	Diode, Zener	1N5234B (6.2 V)	530093
CR1202	Diode, Zener	1N5234B (6.2 V)	530093
CR1203	Diode, Sig.	1N914	530058
CR1204	Diode, Sig.	1N914	530058
IC1201	Integrated Circuit	SN74L00N NAND Gate	534002
IC1202	Integrated Circuit	MK5002P Decade Counter	534024
J1202	Connector	Amp 583485-8 (6 Pos. Dual)	479277
J1203	Connector	Amp 583485-8 (6 Pos. Dual)	479277
J1204	Connector	Amp 583485-8 (6 Pos. Dual)	479277
Q1201 through Q1208	Transistor, PNP	MPS6516	528037
Q1209	Transistor, NPN	MPS6507	528070
Q1210	Transistor, NPN	MPS6512	528059
Q1211	Transistor, NPN	MPS6512	528059
Q1212	Transistor, NPN	MPS6512	528059
Q1213	Transistor, PNP	2N5087	528042
Q1214	Transistor, NPN	MPS6512	528059
Q1215 through Q1218	Transistor, PNP	2N5087	528042
Q1219	Transistor, NPN	MPS6512	528059
Q1220	Transistor, Unijunction	MPU131	528062
Q1221 through Q1224	Transistor, PNP	2N5087	528042
R1201 through R1206	Resistor, Comp.	27 kΩ 5%	343441
R1207	Resistor, Comp.	2 kΩ 5%	343329
R1208	Resistor, Comp.	1 kΩ 5%	343300
R1209	Resistor, Comp.	5.1 kΩ 5%	343368
R1210	Resistor, Comp.	5.1 kΩ 5%	343368
R1211 through R1214	Resistor, Comp.	100 kΩ 5%	343500
R1215	Resistor, Comp.	27 kΩ 5%	343441
R1216 through R1220	Resistor, Comp.	5.1 kΩ 5%	343368
R1221	Resistor, Comp.	27 kΩ 5%	343441
R1222	Resistor, Comp.	3 kΩ 5%	343346
R1223	Resistor, Comp.	680 Ω 5%	343280
R1224	Resistor, Comp.	430 Ω 5%	343261
R1225	Resistor, Comp.	680 Ω 5%	343580
R1226	Resistor, Comp.	100 kΩ 5%	343500
R1227	Resistor, Comp.	680 kΩ 5%	343580
R1228	Resistor, Comp.	5.1 kΩ 5%	343368
R1229	Resistor, Comp.	330 Ω 5%	343250
R1230	Resistor, Comp.	4.7 MΩ 5%	343665

Reference	Description		BEC Part No.
		COUNTER P. C. BOARD (CONTINUED)	
R1231 through R1234	Resistor, Comp.	5.1 kΩ 5%	343368
R1235	Resistor, Comp.	430 Ω 5%	343261
		DISPLAY P. C. BOARD	
CR1301 through CR1304	Diode, Sig.	1N914	530058
DS1301	Numeric Display	MAN3620	536805
DS1302	Numeric Display	MAN3620	536805
DS1303	Numeric Display	MAN3620	536805
DS1304	Lamp	583DX (5 V)	545127
DS1305	Lamp	2200D (5 V)	545120
DS1306	Lamp	2200D (5 V)	545120
DS1307	Lamp	2200D (5 V)	545120
DS1308	Numeric Display	MAN3620	536805
DS1309	Lamp	2200D (5 V)	545120
DS1310	Lamp	2200D (5 V)	545120
DS1311	Lamp	2200D (5 V)	545120
Q1301 through Q1307	Transistor, NPN	MPS6512	528059
Q1308 through Q1311	Transistor, FET	MPSA12	528052
Q1312	Transistor, PNP	2N5087	528042
R1301 through R1307	Resistor, Comp.	47 Ω 5%	343165
R1308 through R1311	Resistor, Comp.	27 kΩ 5%	343441
R1312	Resistor, Comp.	33 Ω 5%	343150
		A/D CONVERTER P. C. BOARD	
A1401	Op Amp Follower	LM310 Only	535005
A1402	Op Amp	LM301AN	535012
A1403	Op Amp Follower	LM310 Only	535005
A1404	Op Amp Comparator	LM311	535006
C1401	Capacitor, Elec.	1 pF 10% 35 V	283216
C1402	Capacitor, Elec.	1 pF 10% 35 V	283216
C1403	Capacitor, PC	0.1 pF 10% 50 V	234115
C1404	Capacitor, Cer.	33 pF 5% 500 V	224139
C1405	Capacitor, Elec.	1 pF 10% 35 V	283216
C1406	Capacitor, PC	100 nF 10% 50 V	234046
CR1401	Diode, Zener	1N821 (6.2 V)	530050
CR1402	Diode, Zener	1N821 (6.2 V)	530050
CR1403	Diode, Sig.	1N914	530058
CR1404	Diode, Sig.	1N914	530058
CR1405	Diode, Sig.	1N914	530058

Reference	Description		BEC Part No.
		A/D CONVERTER P. C. BOARD (CONTINUED)	
IC1401	Integrated Circuit	CD4016AE Quad Switch	534007
IC1402	Integrated Circuit	CD4013AE Dual "D" Binary	534021
IC1403	Integrated Circuit	CD4011AE NAND Gate	534022
IC1404	Integrated Circuit	CD4001AE NOR Gate	534023
Q1401	Transistor, FET	Selected	528068
R1401	Resistor, MF	30.9 kΩ 1%	341447
R1402	Resistor, MF	30.9 kΩ 1%	341447
R1403	Resistor, MF	5.49 kΩ 1%	341371
R1404	Resistor, MF	5.49 kΩ 1%	341371
R1405	Resistor, Var.	5 kΩ 20% 1/2 W	311293
R1406	Resistor, MF	1.15 kΩ 1%	341306
R1407	Resistor, MF	200 kΩ 1%	341529
R1408	Resistor, Var.	5 kΩ 20% 1/2 W	311293
R1409	Resistor, Comp.	330 Ω 5%	343250
R1410	Resistor, Comp.	10 kΩ 5%	343400
R1411	Resistor, MF	1.15 kΩ 1%	341306
R1412	Resistor, Comp.	27 kΩ 5%	343441
R1413	Resistor, Comp.	4.7 MΩ 5%	343665
R1414	Resistor, Comp.	680 Ω 5%	343280
R1415	Resistor, Comp.	27 kΩ 5%	343441
R1416	Resistor, Comp.	5.1 kΩ 5%	343368
R1417	Resistor, Comp.	10 kΩ 5%	343400
R1418	Resistor, Comp.	4.7 MΩ 5%	343665
R1419	Resistor, Comp.	1 MΩ 5%	343600
R1420	Resistor, Comp.	47 kΩ 5%	343465
		OPTION -09 dBm DISPLAY	
A601	Op. Amp.	LM301AN	535012
A602	Op. Amp.	LM301AN	535012
A603	Op. Amp.	LM301AN	535012
C601	Capacitor, Mica	150 pF ± 5% 500 V	200032
C602	Capacitor, Mica	20 pF ± 5% 500 V	200027
C603	Capacitor, Cer.	33 pF ± 5% 500 V	224139
C604	Capacitor, Mica	300 pF ± 5% 500 V	200034
C605	Capacitor, Mica	300 pF ± 5% 500 V	200034
CR602	Diode, Zener	1N821 (6.2 V)	530050
CR605	Diode, Zener	1N5237 (8.2 V)	530125
CR606	Diode, Sig.	1N914	530058
0601	Transistor, FET	HDGP-1000	528066
0603	Transistor, FET	HDGP-1000	528066
0605	Transistor, FET	HDGP-1000	528066
0610	Transistor, NPN	CA3046	528058
R601	Resistor, MF	250 kΩ 0.1% 3/8 W	340526
R603	Resistor, MF	500 kΩ 0.19% 3/8 W	340564
R605	Resistor, MF	1.00 MΩ 0.1% 3/8 W	340599
R610	Resistor, Var.	20 k 10% 1 W	311266
R611	Resistor, MF	71.5 kΩ 1%	341482
R612	Resistor, MF	64.9 kΩ 1%	341478
R613	Resistor, Comp.	68 kΩ 5%	344480
R616	Resistor, Var.	5 kΩ 10% 1 W	311268
R617	Resistor, MF	64.9 kΩ 1%	341478

Reference	Description		BEC Part No.
	OPTION -09 dbm DISPLAY (CONTINUED)		
R618	Resistor, MF	15.8 kΩ 1%	341419
R622	Resistor, Comp.	39 kΩ 5%	344457
R623	Resistor, Comp.	2 kΩ 5%	344329
R624	Resistor, Var.	5 kΩ 10% 1 W	311268
R625	Resistor, MF	64.9 kΩ 1%	341478
R627	Resistor, Comp.	1.1 kΩ 5%	344304
R628	Resistor, MF	4.75 kΩ 1%	341365
R629	Resistor, MF	4.75 kΩ 1%	341365
R630	Resistor, MF	100 kΩ 1%	341500
RT601	Thermistor	1 kΩ 1%	325006
	OPTION -16 SERIAL/PARALLEL BCD CONVERTER		
IC101 through IC104	Integrated Circuit	SN74L98N 4 Bit Converter	534046
IC105	Integrated Circuit	SN74L74N Dual D Flip-Flop	534003
J105	Receptacle	Ampenol 225-22221-103 (Dual 22 Pin)	479254
J801	Receptacle	Amphenol 225-22Z21-101 (Dual 22 Pin)	479259


R1301
Q1303
R1303
R1304
Q1306
R1306
R1307
Q1309
Q1310
Q1311
DS1305
DS1309
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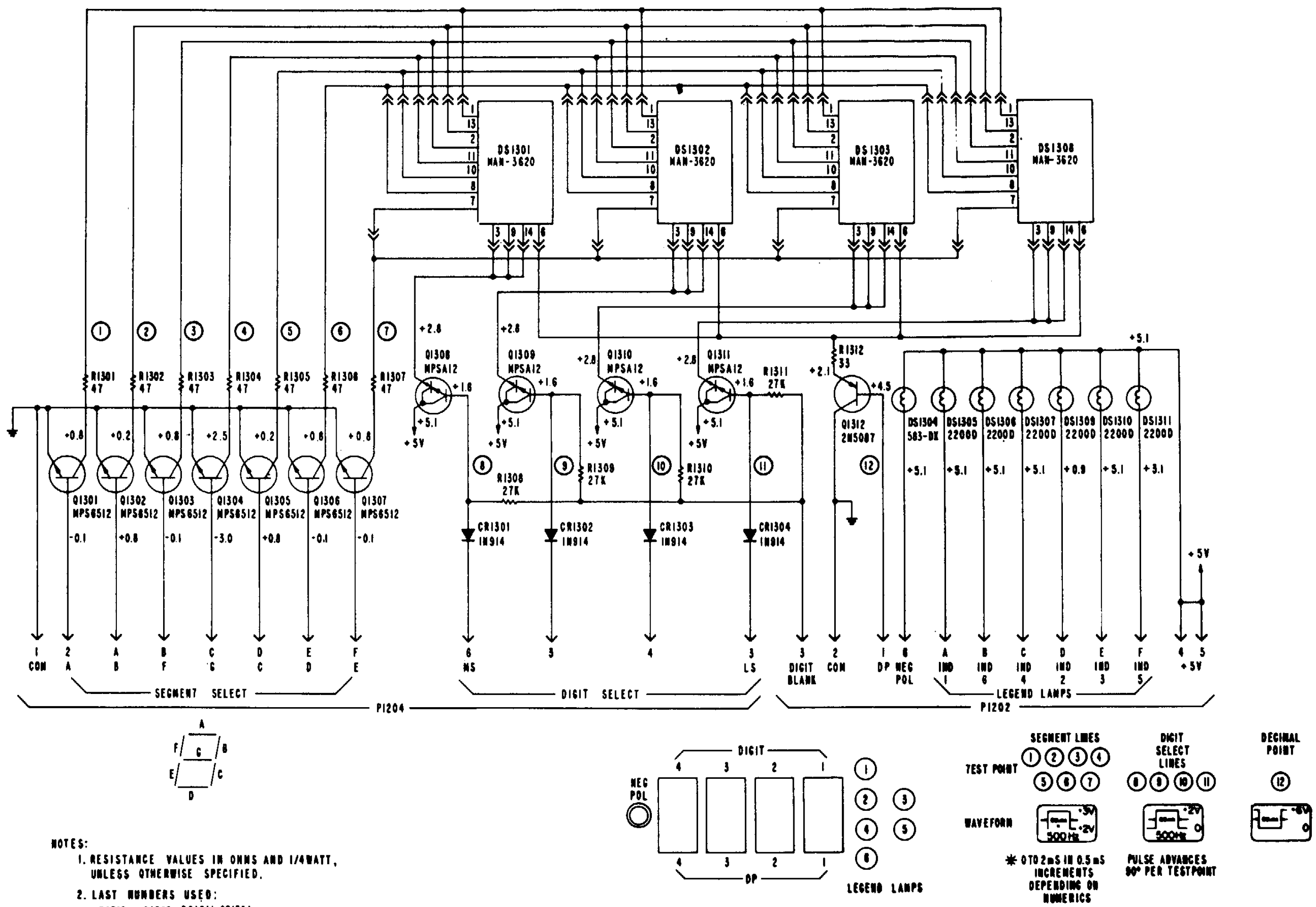
DS1307
DS1311
DS1306
P1202



NOTES:

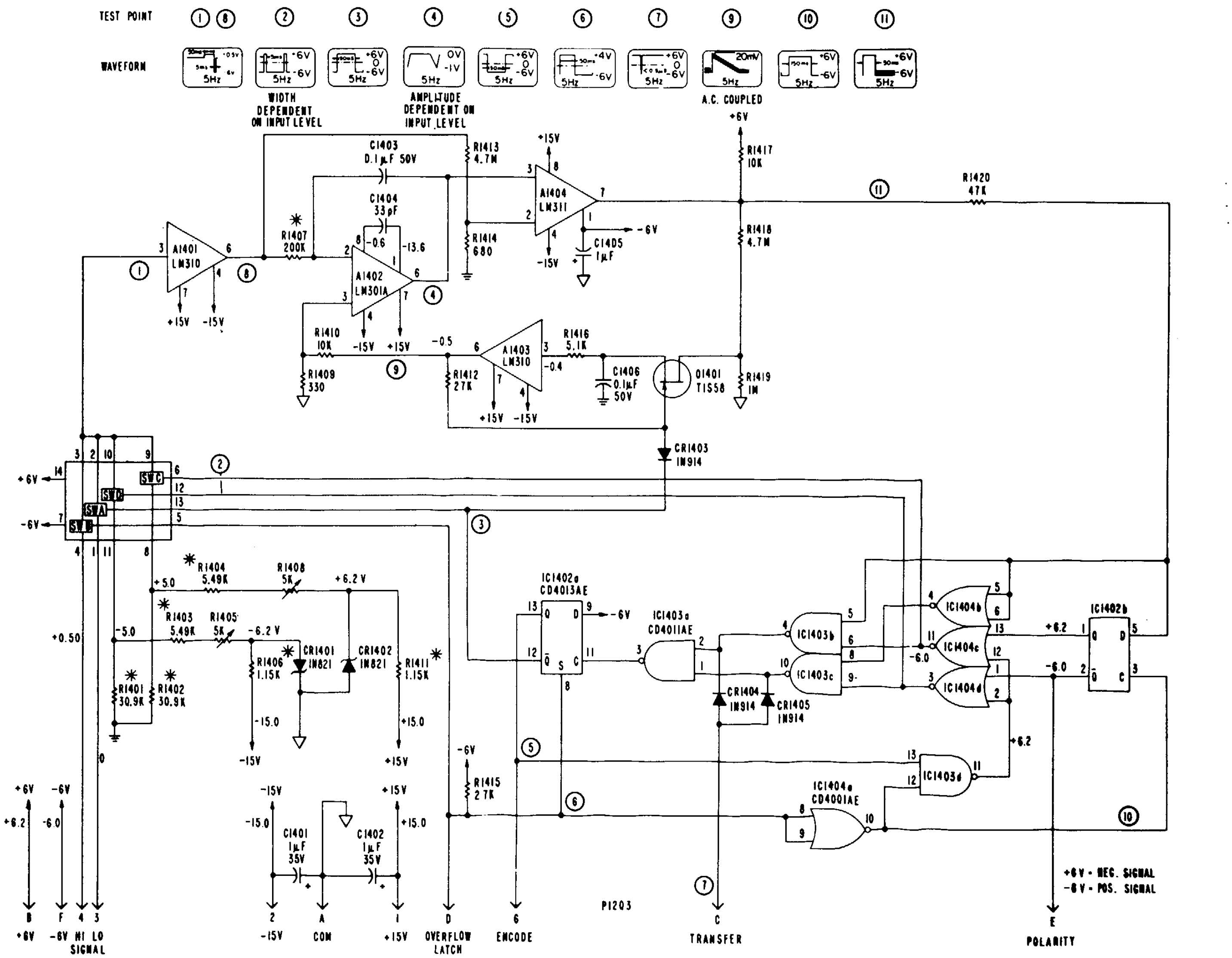
1. RESISTANCE VALUES IN OHMS AND 1/4WATT, UNLESS OTHERWISE SPECIFIED.
2. LAST NUMBERS USED: R1312, Q1312, DS1311, CR1304
3. TEST CONDITIONS: ALL MEASUREMENTS WITH 0.5Vdc INPUT (1000 COUNTS). ALL VALUES NOMINAL

BOONTON ELECTRONICS CORPORATION

MODEL DPM

Schematic, DISPLAY BOARD

D830546G



NOTES:

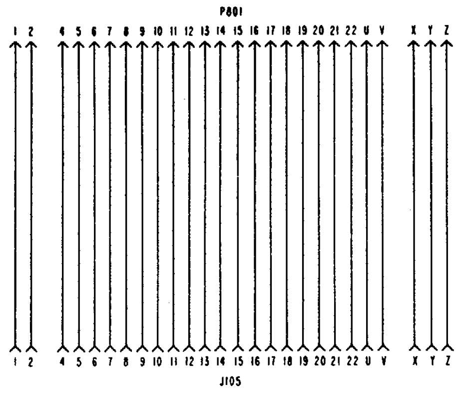
1. RESISTANCE VALUES IN OHMS AND 1/4 WATT, UNLESS OTHERWISE SPECIFIED.
2. ✳ PRECISION RESISTOR.
3. TEST CONDITIONS: ALL MEASUREMENTS MADE WITH +0.5 Vdc INPUT (1000 COUNTS). ALL VALUES NOMINAL.
4. LAST NUMBERS USED: R1420 C1406
5. ⏚ COMMON

BOONTON ELECTRONICS CORPORATION

MODEL DPM

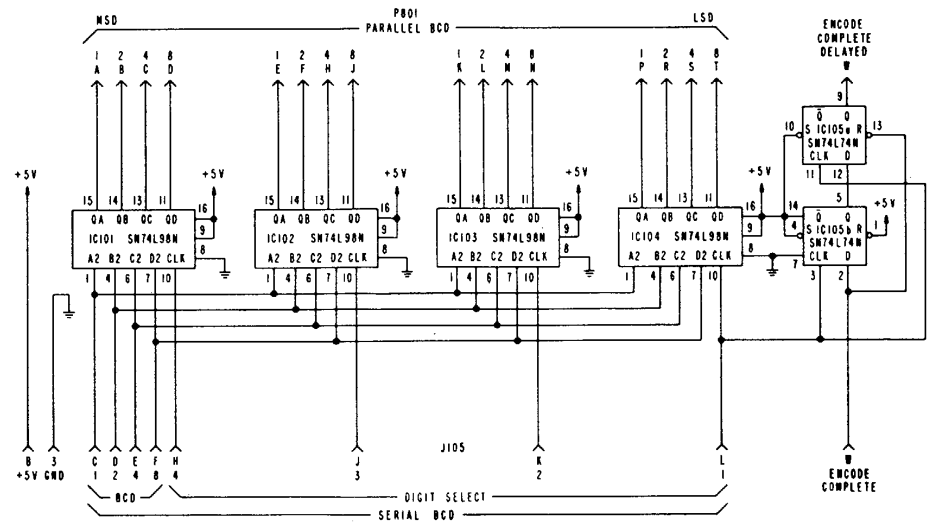
Schematic, A/D Converter

D830546C



PIN ASSIGNMENTS

P801	428D	928D	728D	P801	428D	928D	728D	
1			HI TERM BIAS ±	A	1			MSD
2	- dBm		LO TERM BIAS ±	B	2			MSD
3				C	4			MSD
4	ANALOG OUTPUT			D	8			MSD
5	COMMON			E	1			BCD ENCODED DATA
6	AUTO ENABLE			F	2			BCD ENCODED DATA
7	MANUAL DISABLE			H	4			BCD ENCODED DATA
8	dBm ENABLE			J	8			BCD ENCODED DATA
9		3000 mV		K	1			BCD ENCODED DATA
10	10 mW	1000 mV	2000 pF	L	2			BCD ENCODED DATA
11	1 mW	300 mV		M	4			BCD ENCODED DATA
12	100 µW	100 mV	200 pF	N	8			BCD ENCODED DATA
13	10 µW	30 mV		P	1			LSD
14	1 µW	10 mV	20 pF	R	2			LSD
15	100 nW	3 mV		S	4			LSD
16	10 nW	1 mV	2 pF	T	8			LSD
17	4 (RANGE CODE)		2 (RANGE CODE)	U				
18	2 (RANGE CODE)		1 (RANGE CODE)	V	TRIGGER			ENCODE
19	1 (RANGE CODE)			W	COMPLETE			ENCODE
20	UNDERRANGE "NOT"			X	HOLD			ENCODE
21	OVERRANGE "NOT"			Y				
22	PWR MODE	mV MODE	POLARITY	Z				



NOTE:
1. LOGIC LEVEL; TTL/DTL COMPATIBLE.

BOONTON ELECTRONICS CORPORATION

MODEL DPM

Schematic, DISPLAY BOARD

D830546G

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	Index of Modification Work Orders.
TM 11-6625-2857-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Repair Parts and Special Tools) for Microwattmeter, Boonton Model 42BD with Power Detector 41-4E.
TM 38-750	The Army Maintenance Management System (TANSS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel'to Prevent Enemy Use (Electronics Command).

APPENDIX B
COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

B-1. Scope
This appendix lists integral components of and basic issue items for Boonton Model 42BD with Power Detector 41-4E Microwattmeter to help you inventory items required for safe and efficient operation.

B-2. General
This Components of End Item List is divided into the following sections:

a. Section II. Integral Components of the End Item. These items, when assembled, comprise the microwattmeter and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III. Basic Issue Items. Not applicable.

B-3. Explanation of Columns

a. Illustration. This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration on which the item is shown.

(2) *Item number.* The number used to identify item called out in the illustration.

b. National Stock Number. Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Description. Indicates the Federal item name and, if required, a minimum description to identify the item. The part number indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. Following the part number, the Federal Supply Code for Manufacturers (FSCM) is shown in parentheses.

d. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

e. Usable on Code. Not applicable.

f. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

g. Quantity. This column is left blank for use during an inventory. Under the Rcvd column, list the quantity you actually receive on your major item. The Date columns are for your use when you inventory the major item.

(Next printed page is B-2)

SECTION II INTEGRAL COMPONENTS OF END ITEM

(1) ILLUSTRATION (A) FIG.	(B) ITEM	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION PART NUMBER	CAGE	(4) LOCATION	(5) USUABLE ON CODE	(6) QTY REQD	(7) QUANTITY RCVD	DATE
11		6625-01-050-8800	MICROWATTMETER 42BD	(O49C1)			1		
12			POWER DETECTOR 41-4E	(04901)			1		

APPENDIX D
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

D. General

This appendix provides a summary of the maintenance operations for Microwattmeter Boonton Model 42BD. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical Characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy', to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications.

Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/ components.

D-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C-Operator/Crew
O-Organizational
F-Direct Support
H-General Support
D-Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (Sect. III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer’s part number of the tool followed by the Federal Supply Code for manufacturers (5digit) in parentheses.

D-5. Remarks (Sect. IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

(Next printed page is D-3)

SECTION II. MAINTENANCE ALLOCATION CHART FOR MICROWATTMETER, BOONTON 42BD WITH POWER DETECTOR 41-4E

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	RF POWER METER, BOONTON MODEL 42BD, OPTIONS 1 AND 9	Inspect		0.3					
		Test			0.4				
		Align			0.6				
		Adjust			0.4			1 thru 4	
		Calibrate			2.0				
		Replace			0.3				
		Repair			1.0				
01	CIRCUIT CARD ASSEMBLY, AMPLIFIER, Al	Inspect			0.3			1 thru 4	
		Replace			0.5				
		Repair					1.0		A
02	CIRCUIT CARD ASSEMBLY, CHOPPER DRIVER, A2	Inspect			0.3			1 thru 4	
		Replace			0.2				
		Repair						1.0	A
03	CIRCUIT CARD ASSEMBLY, SHAPING AMPLIFIER, Ah	Inspect			0.3			1 thru 4	
		Replace			0.2				
		Repair						1.0	A
04	CIRCUIT CARD ASSEMBLY, DIGITAL CONTROL, A5	Inspect			0.3			1 thru 4	
		Replace			0.2				
		Repair					1.0		A
05	CIRCUIT CARD ASSEMBLY, AUTO RANGE, A6	Inspect			0.3			1 thru 4	
		Replace			0.2				
		Repair					1.0		A
06	CIRCUIT CARD ASSEMBLY, COUNTER, A7	Inspect			0.3			1 thr4 L	
		Replace			0.2				
		Repair					1.0		A
07	CIRCUIT CARD ASSEMBLY, DISPLAY, Al	Inspect			0.3			1 thrum	
		Replace			0.4				
		Repair					1.0		A
08	CIRCUIT CARD ASSEMBLY, ANALOG-DIGITAL CONVERTER, A9	Inspect			0.3			1 thru 4	
		Replace			0.2				
		Repair					1.0		A
09	RF DETECTOR, BOONTON MODEL 41-4E	Inspect			0.3				
		Replace		0.2					

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR AN/GRC-240

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	F, D	OSCIILOSOOS ANM/USM-281C	6625-00-106-7497	
2	F, D	DUAL CNANNEL PLUG-IN TEKTRONIX MODEL 7A18N	6625-00-753-5009	
3	F, D	PROBE, TEKTRONIX MODEL P6035 (2 req'd)	6625-00-006-8667	
4	F, D	TOOL KIT ELECTRONIC EQUIPMENT TK-105/G	5180-00-542-4489	

SECTION IV. REMARKS FOR RADIO SET AN/GRC-240

REFERENCE CODE	REMARKS
A	NEITHER REPAIR PARTS NOR REPAIR PROCEDURES ARE FURNISHED. DEPOT WILL REPAIR OR REPLACE AT THEIR DISCRETION.

*U.S. GOVERNMENT PRINTING OFFICE: 1978-703-128-314

By Order of the Secretary of The Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:
J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
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TSG (1)
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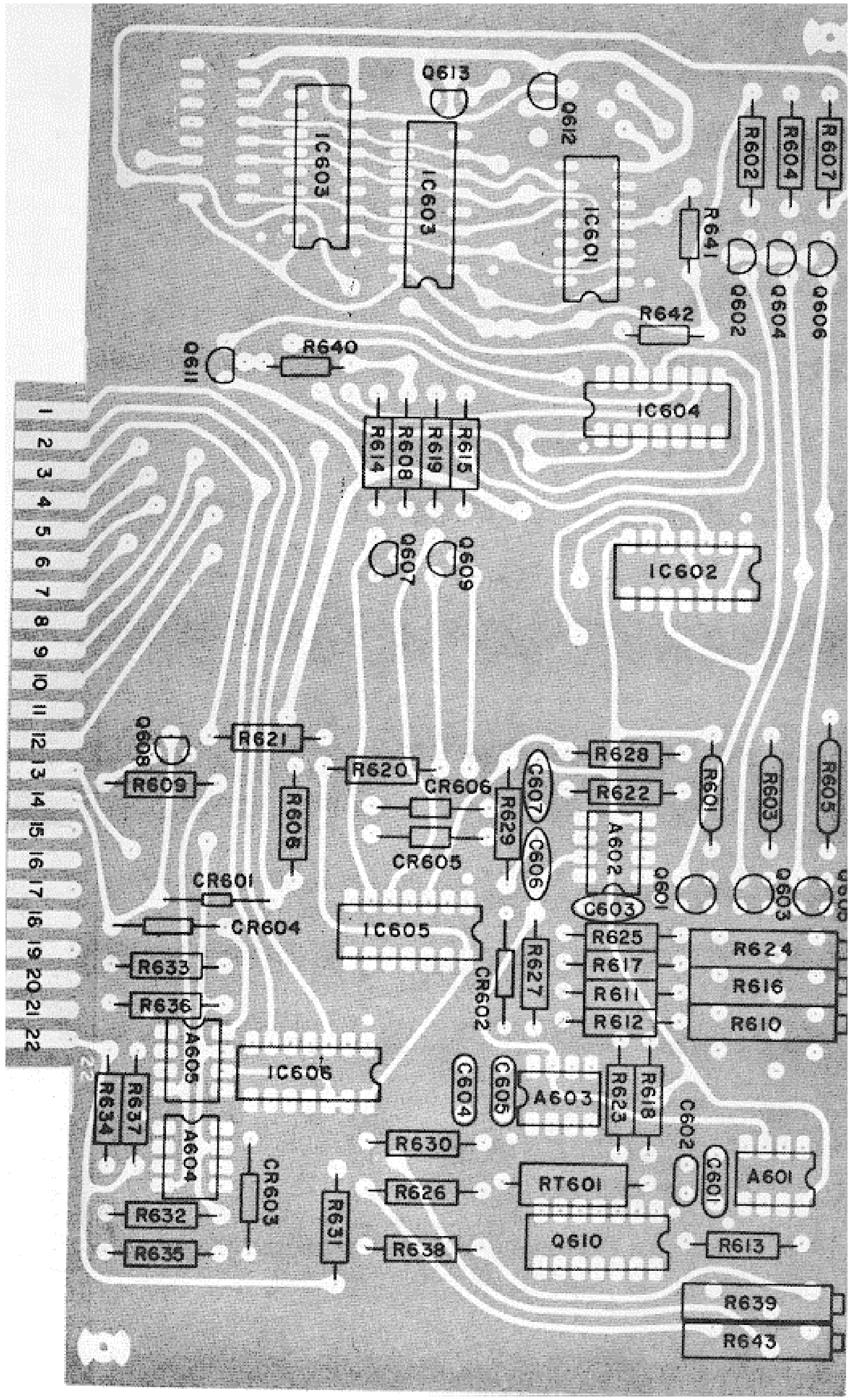
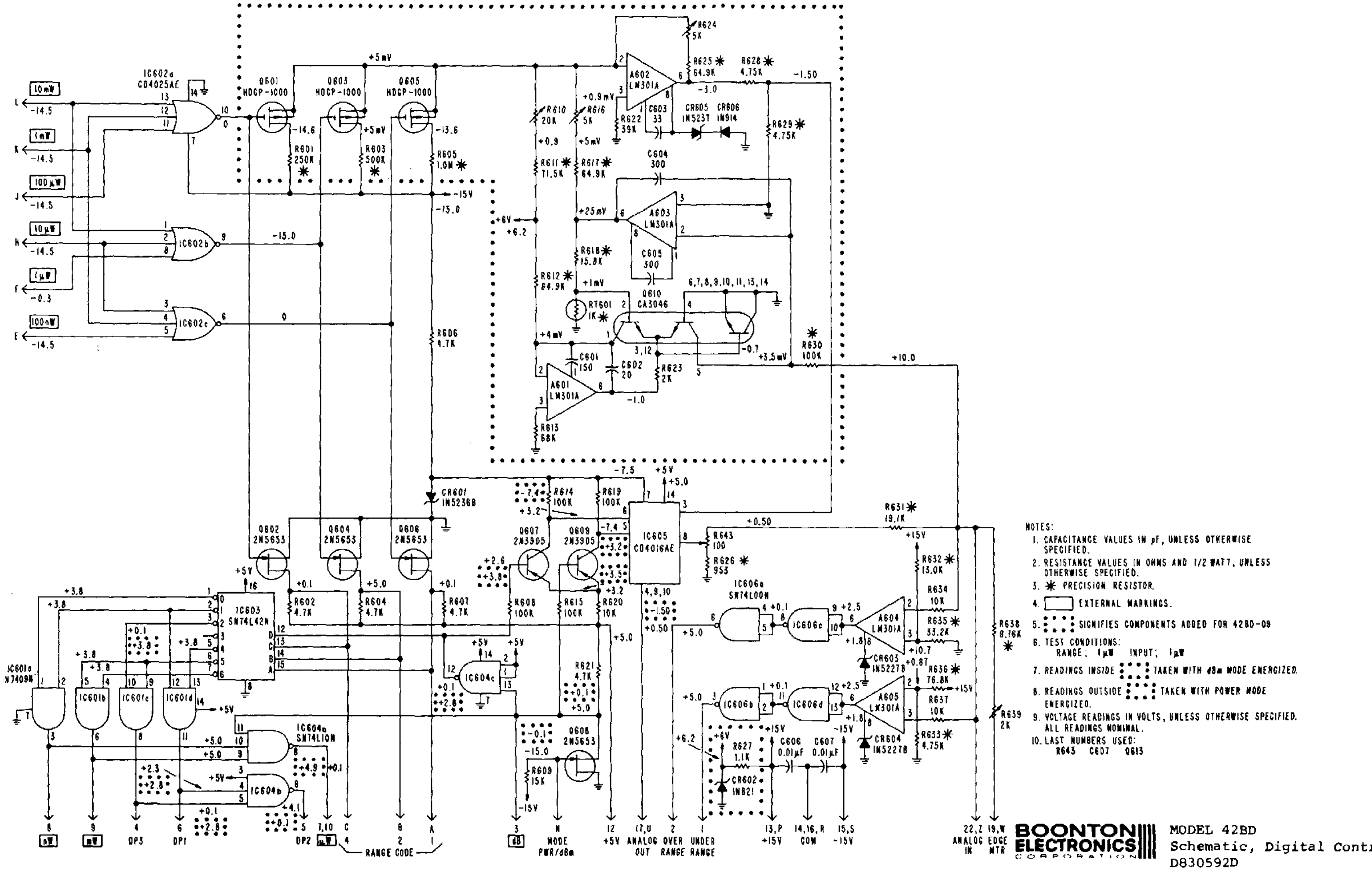
Airmies (1)
USASIGS (10)
Svc Colleges (1)
Ft Monmouth (HISA) (33)
Fort Huachuca (5)
Ft Richardson (CERCOM) (1)
Fort Gillem (5)
WSMR (1)
Fort Carson (5)
USAERDAA (1)
USAERDAW (1)
Army Dep (1) except
LBAD (10)
SAAD (30)
TOAD (14)
SHAD (3)
USA Dep (1)
Sig Sec USA Dep (1)
Units org under fol TOE:
(1 cy each unit USOINDC)
29-134
29-136
29-207 (2)
29-610 (2)
NG: None
USAR: None
For explanation of abbreviations used, see AR 310-50.

*U. S. GOVERNMENT PRINTING OFFICE : 1990 0 - 261-872 (21288)



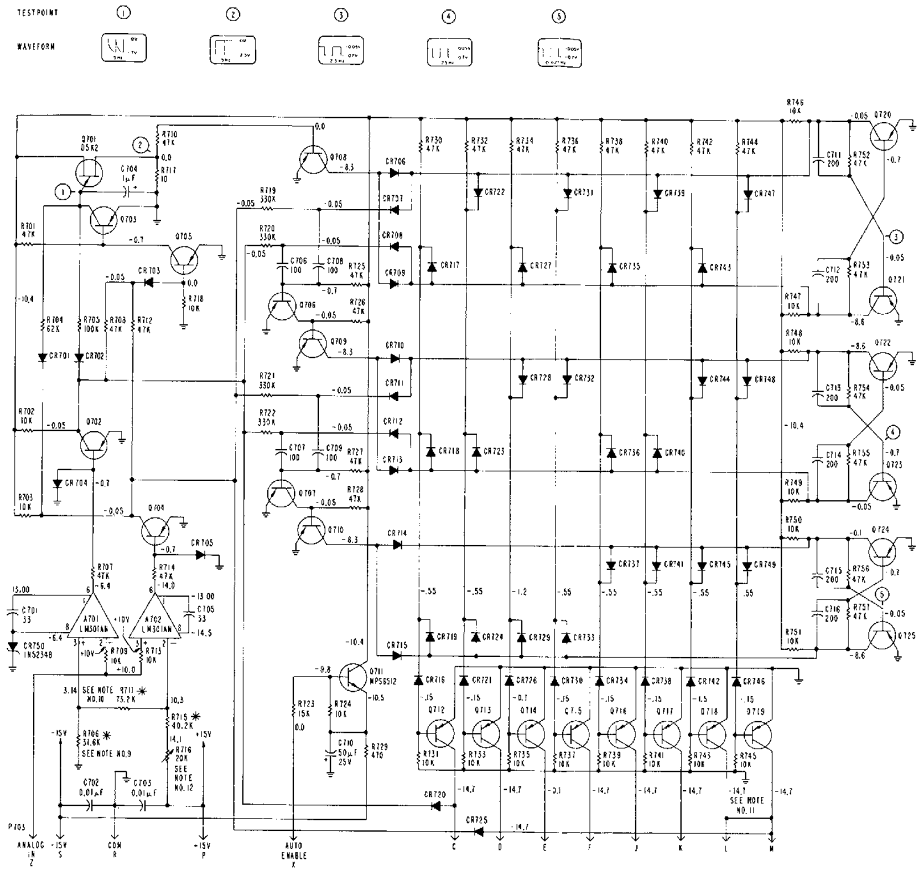


BOONTON ELECTRONICS CORPORATION

MODEL 42BD

Schematic, Digital control

D830592D



FULL SCALE MARKINGS FOR P703

P703	92BD	42BD	42CD
C	1mV	10nW	100nW
D	3mV	100nW	1μW
E	10mV	1μW	10μW
F	30mV	10μW	100μW
J	100 mV	100μW	1mW
K	300mV	1mW	10mW
L	1000 mV	10mW	100mW
M	3000mV	—	—

NOTES:

1 CAPACITANCE VALUES IN pF, UNLESS OTHERWISE SPECIFIED.
2 RESISTANCE VALUES IN OHMS AND 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
3 ✳ PRECISION RESISTORS.
4 ALL TRANSISTORS TO BE TYPE MPS6516, UNLESS OTHERWISE SPECIFIED.
5 ALL DIODES TO BE TYPE IN914, UNLESS OTHERWISE SPECIFIED.
6 WAVESHAPES OCCUR DURING RANGE CHANGE ONLY.
7 ALL VOLTAGE READINGS NOMINAL VOLTS.
8 LAST NUMBERS USED:
R757 C716 Q725 CR750
9 ON MODELS 42BD-01 AND 42CD-01 THIS VALUE IS 9.53 K.
10 ON MODELS 42BD-01 AND 42CD-01 THIS VALUE IS 95.3K.
11 THIS CONNECTION FOR 42BD-01 AND 42CD-01.
12 ON MODELS 42BD-01 AND 42CD-01 THIS VALUE IS 50K.
13 TEST CONDITIONS:

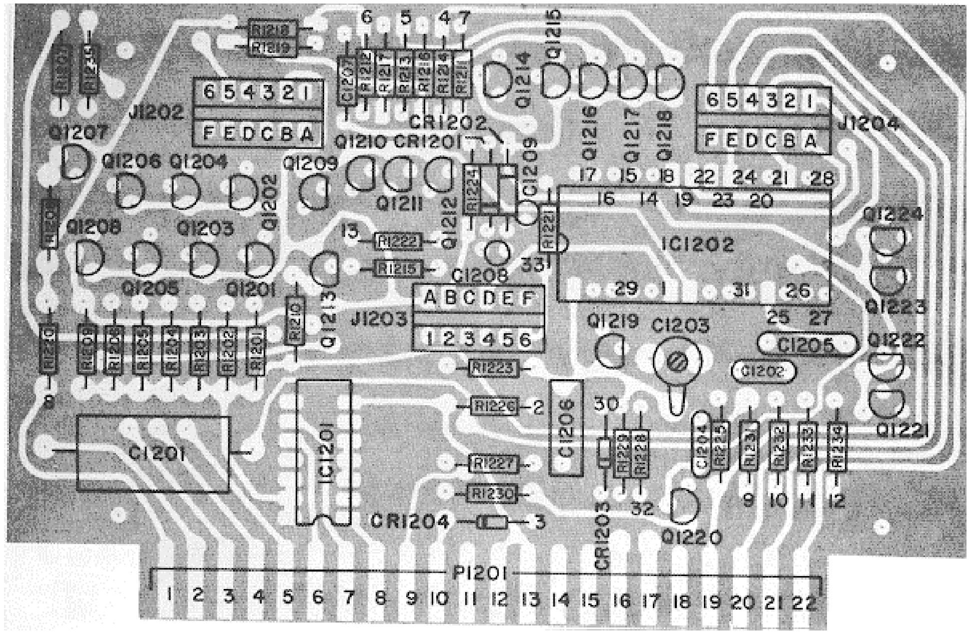
	92BD	42BD	42CD
RANGE	10mV	1μW	10μW
INPUT:	10mV	1μW	10μW

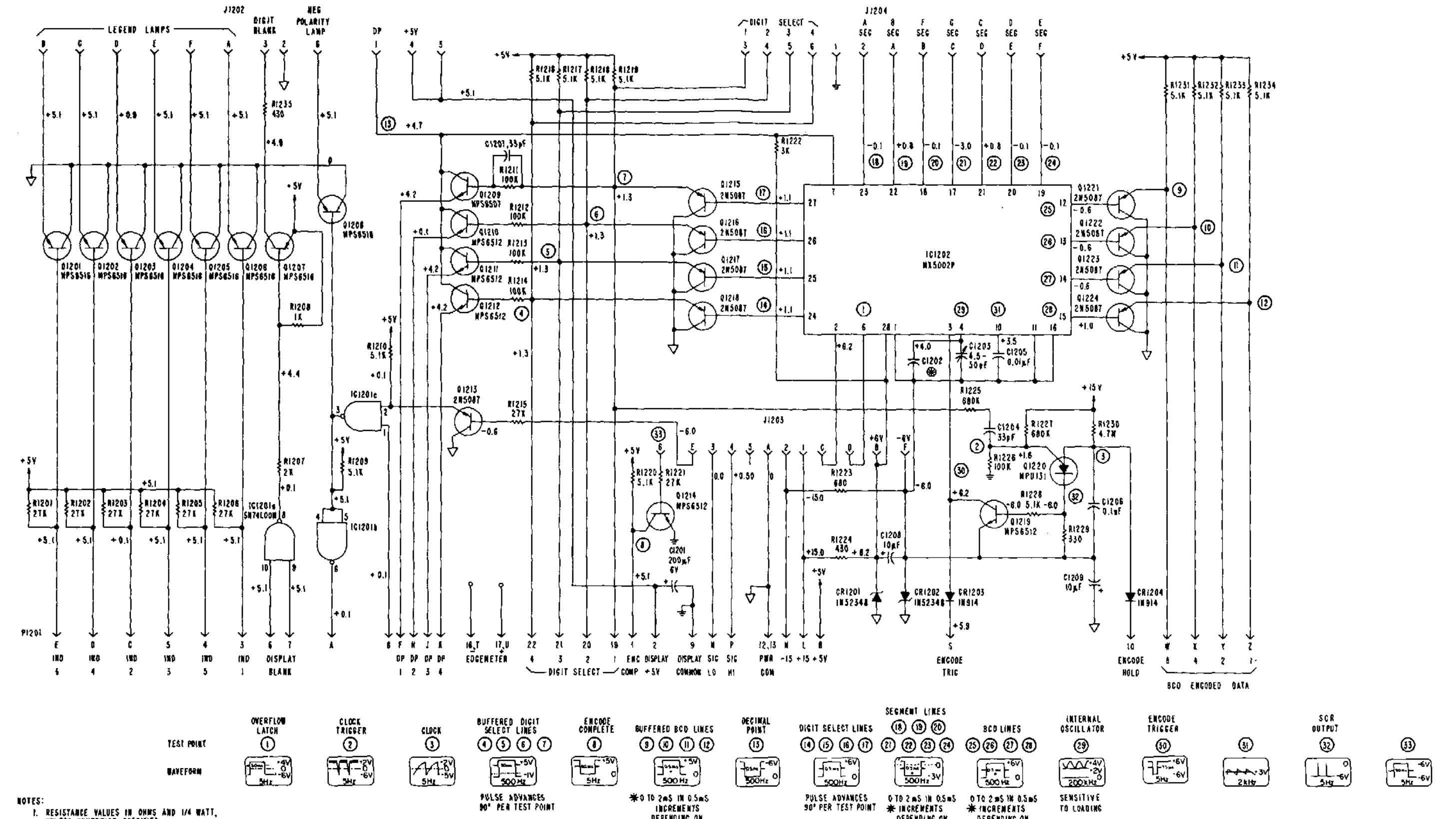
BOONTON ELECTRONICS CORPORATION

MODEL 42 & 92 SERIES

Schematic, Auto Range

D830483E





NOTES:

1. RESISTANCE VALUES IN OHMS AND 1/4 WATT, UNLESS OTHERWISE SPECIFIED.
2. ⊛ FACTORY SELECTED.
3. TEST CONDITIONS:
   ALL MEASUREMENTS MADE WITH +0.5V INPUT. ADJ. R1405 TO +1000 COUNTS.
   ALL VALUES NOMINAL.
4. LAST NUMBERS USED:
   R1235 C1209 Q1224
5. ▽ COMMON

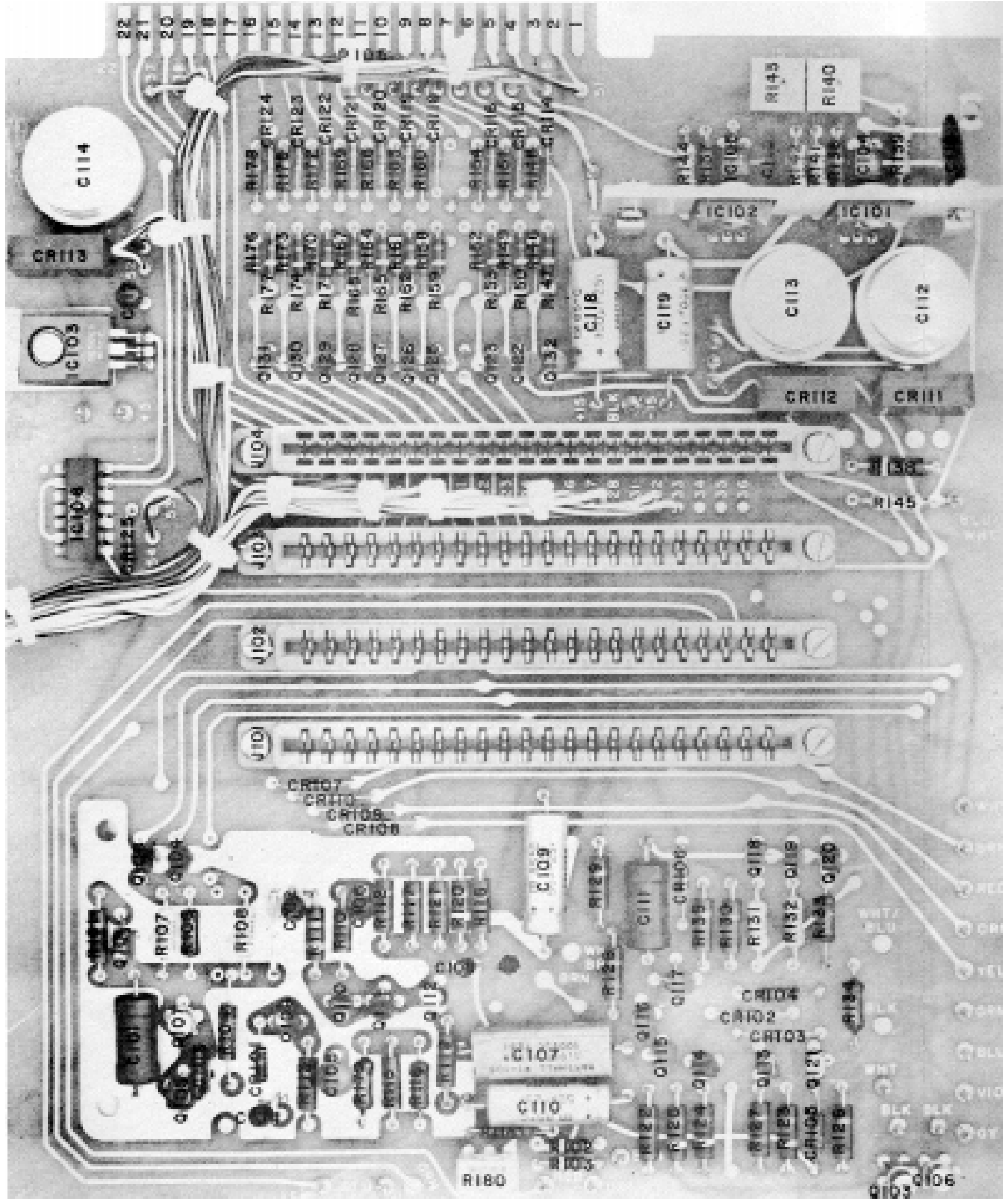
COMPONENT NUMBERS
1200 SERIES

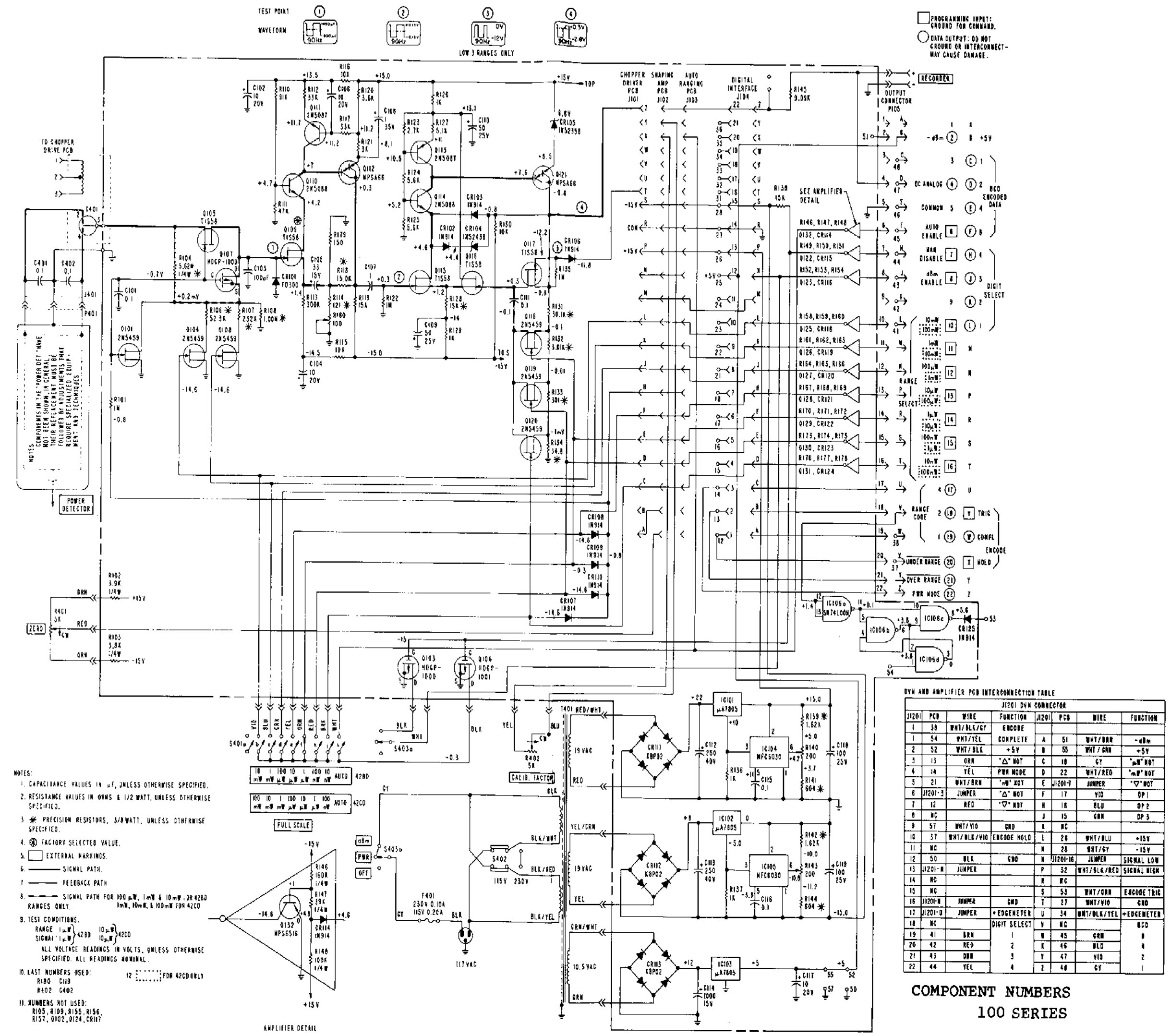
BOONTON ELECTRONICS CORPORATION

MODEL DPM

Schematic, Counter Board

D830546E Sheet





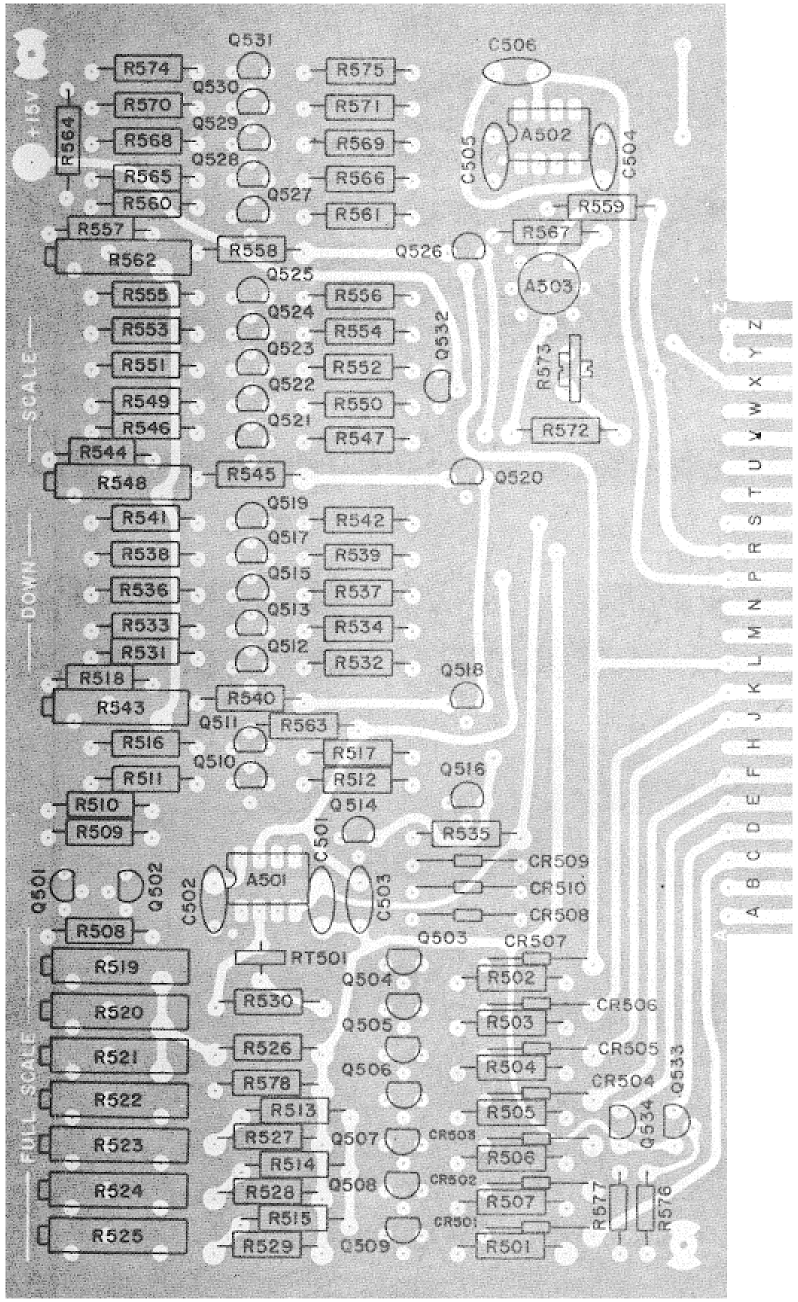
DVM AND AMPLIFIER PCB INTERCONNECTION TABLE

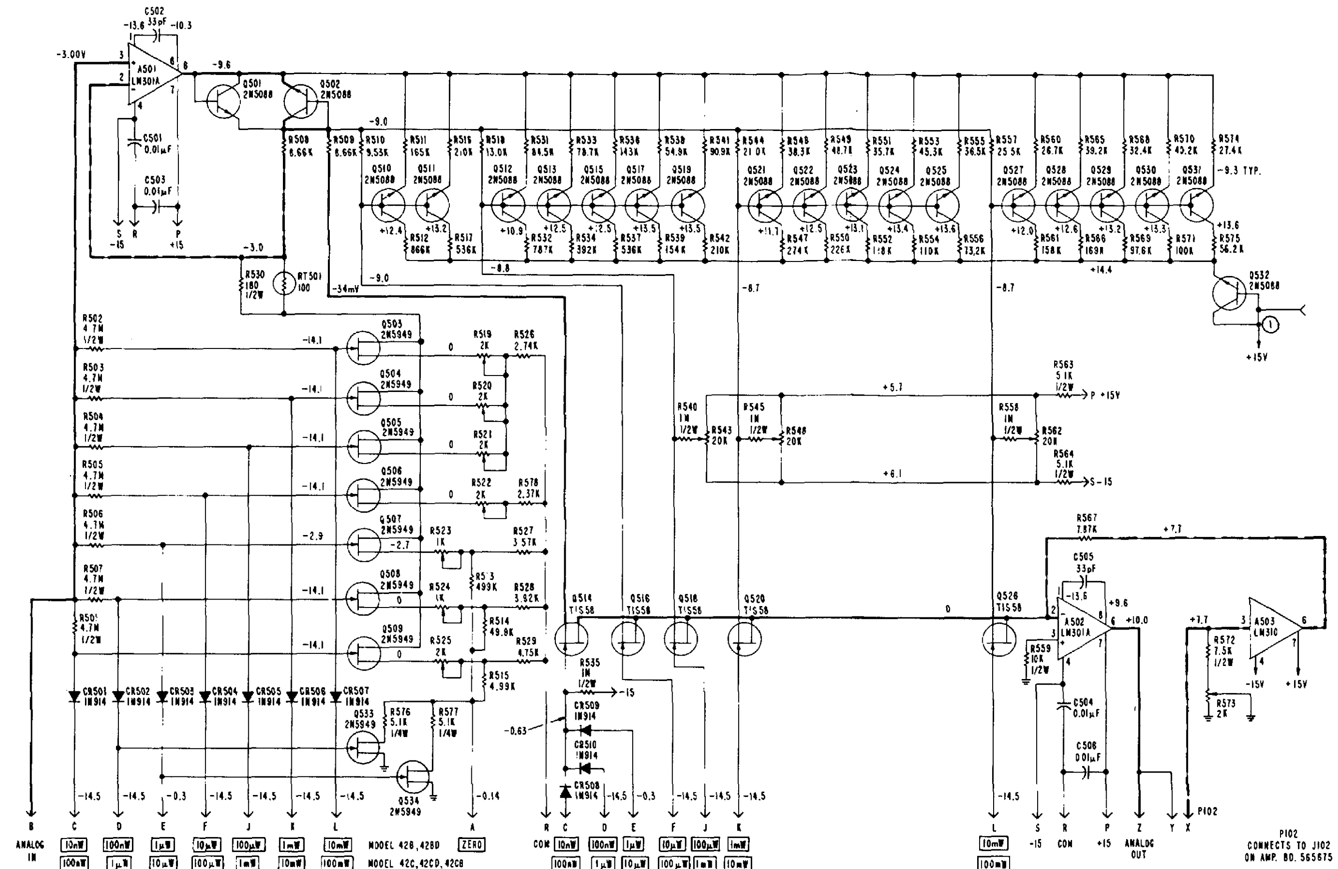
J1201 DVM CONNECTOR							
J1201	PCB	WIRE	FUNCTION	J1201	PCB	WIRE	FUNCTION
1	38	WHT/BLK/GY	ENCODE				
1	54	WHT/YEL	COMPLETE	A	51	WHT/BRN	-dBm
2	52	WHT/BLK	+5V	B	55	WHT/GRN	+5V
3	13	ORN	"Δ" NOT	C	18	GY	"μW" NOT
4	14	YEL	PWR MODE	D	22	WHT/RED	"mW" NOT
5	21	WHT/BRN	"nW" NOT	E	J1201-7	JUMPER	"∇" NOT
6	J1201-3	JUMPER	"Δ" NOT	F	17	VIO	DP 1
7	12	RED	"∇" NOT	H	16	BLU	DP 2
8	NC			J	15	GRN	DP 3
9	57	WHT/VIO	GND	K	NC		
10	37	WHT/BLK/VIO	ENCODE HOLD	L	26	WHT/BLU	+15V
11	NC			M	28	WHT/GY	-15V
12	50	BLK	GND	N	J1201-16	JUMPER	SIGNAL LOW
13	J1201-N	JUMPER		P	32	WHT/BLK/RED	SIGNAL HIGH
14	NC			R	NC		
15	NC			S	53	WHT/GRN	ENCODE TRIG
16	J1201-N	JUMPER	GND	T	27	WHT/VIO	GND
17	J1201-U	JUMPER	+EDGEMETER	U	34	WHT/BLK/YEL	+EDGEMETER
18	NC		DIGIT SELECT	V	NC		BCD
19	41	BRN	1	W	45	GRN	8
20	42	RED	2	X	46	BLU	4
21	43	ORN	3	Y	47	VIO	2
22	44	YEL	4	Z	48	GY	1

COMPONENT NUMBERS
100 SERIES

BOONTON ELECTRONICS CORPORATION

MODEL 42BD, 42CD
Schematic Amplifier
E830592F Sheet 1 of 3





P102 CONNECTS TO J102 ON AMP. BD. 565675

INSTRUMENT	SCHEMATIC
42B	830636
42BD	830592 SHT. 1
42B-18	830640
42B-19	830641
42BB, 42CB	830658 SHT. 1
42C	830636
42CD	830592 SHT. 1

NOTES:
1. RESISTANCE VALUES IN OHMS AND 3/8 WATT, UNLESS OTHERWISE SPECIFIED.
2. ———— SIGNAL PATH.
3. ———— FEEDBACK PATH.
4. ▭ EXTERNAL MARKINGS
5. ○ TEST POINT.
6. LAST NUMBER USED:
   R578 C506 Q534 CR510 A503
7. TEST CONDITIONS:
   RANGE: 1 μW, SIGNAL: 1 μW — 42B, 42BD; RANGE: 10 μW, SIGNAL: 10 μW — 42C, 42CD
   ALL READINGS IN VOLTS, UNLESS OTHERWISE SPECIFIED. ALL READINGS NOMINAL.

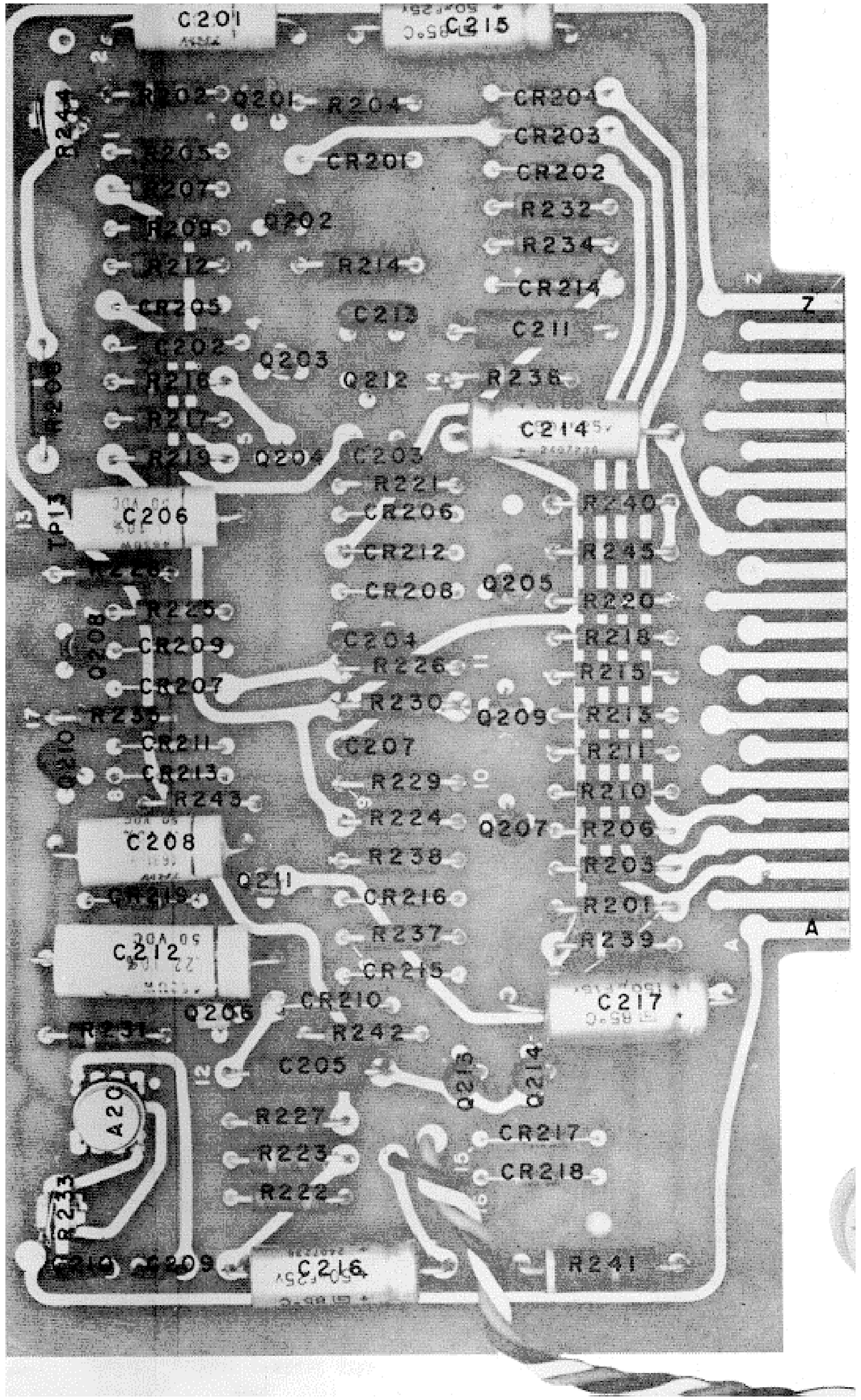
COMPONENT NUMBERS
500 SERIES

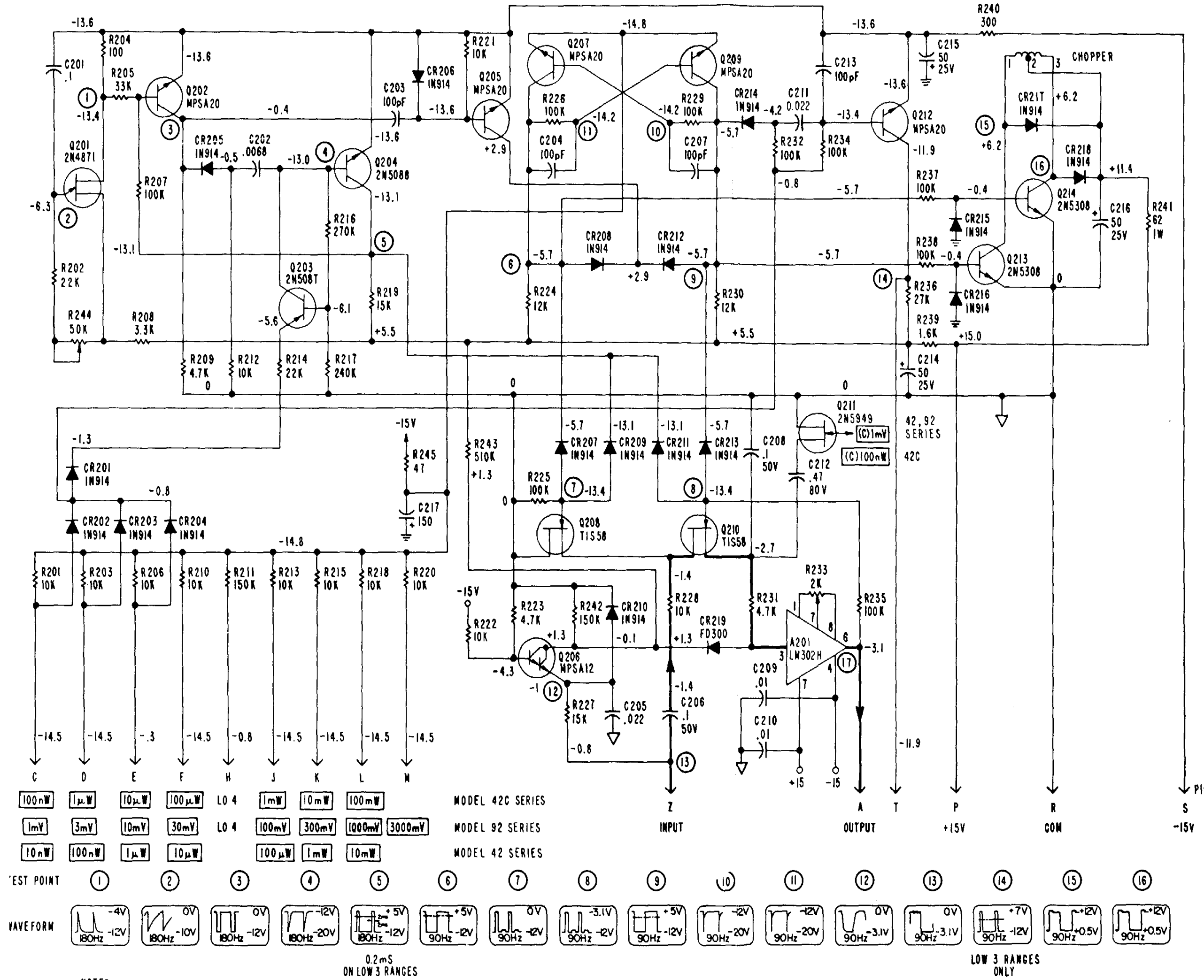
BOONTON ELECTRONICS CORPORATION

MODEL 42B, 42BB, 42BD, 42BD-S7, 42C, CB, CD

Schematic, Shaping Amplifier

E830592H (Sheet 2 of 3)





NOTES:

1. CAPACITANCE VALUES IN µF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS & 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
3. [ ] EXTERNAL MARKINGS.
4. ▽ COMMON
5. ——— SIGNAL PATH
6. TEST CONDITIONS:
   10mV RANGE / 10mV SIGNAL } 42,92 SERIES; 10 µW RANGE / 10 µW SIGNAL } 42C ONLY
   ALL VOLTAGES NOMINAL. ALL READINGS IN VOLTS, UNLESS OTHERWISE SPECIFIED.
8. LAST NUMBERS USED:
   R245 C217 Q214 CR219 A201

P101
CONNECTS TO J101
ON AMP. BD. 565675

INSTRUMENT	SCHEMATIC
42B	830636
42BB	830658 SHT. I
42BD	830592 SHT. I
42B-18	830640
42B-19	830641
92B	830605
92BD	830581 SNT. I
42C	830636
42CD	830592 SHT. I
42CB	830658 SHT. I

COMPONENT NUMBERS
200 SERIES

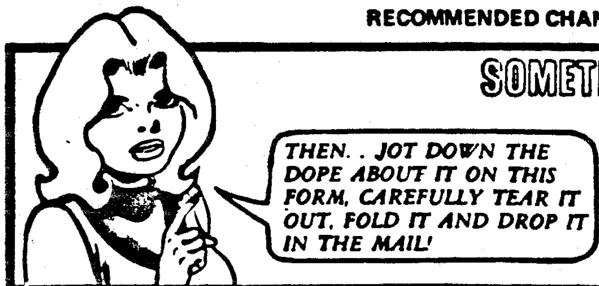
BOONTON ELECTRONICS CORPORATION

MODEL 42B, BB, BD, C, CB, CD 92B, BB, BD

Schematic, Chopper Driver

D830581K (Sheet 3 of 3)

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



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