OPERATING PRACTICE
for the
704A2
WIDE BAND TEST SET

HALCYON
A Torotel Company

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1. GENERAL INFORMATION

A. Operating Practice

1.01 This practice provides operating instructions for the Halcyon 704A2 Wide Band Test Set. (See figure 1.)

1.02 Seven sections are included in this practice. Section 1 contains general information about the 704A2; Section 2 lists its specifications; Section 3 provides information on 704A2 options and accessories. Section 4 supplies the instructions necessary to install the 704A2 and connect it to a power source. Section 5 gives a detailed description of 704A2 controls and indicators that may be used for reference purposes. Section 6 provides the complete operating instructions for the 704A2; to learn to use the unit quickly, simply turn to section 6 and follow the instructions for the particular test to be performed. Section 7 provides operating flow charts.

1.03 This practice will be reissued periodically to reflect equipment modifications. Whenever this practice is reissued, the reason will be listed in this paragraph.

B. 704A2 Wide Band Test Set

1.04 The 704A2 Wide Band Test Set is a multifunction instrument designed to measure circuit parameters that affect transmission over voice-frequency channels, program channels, and wideband

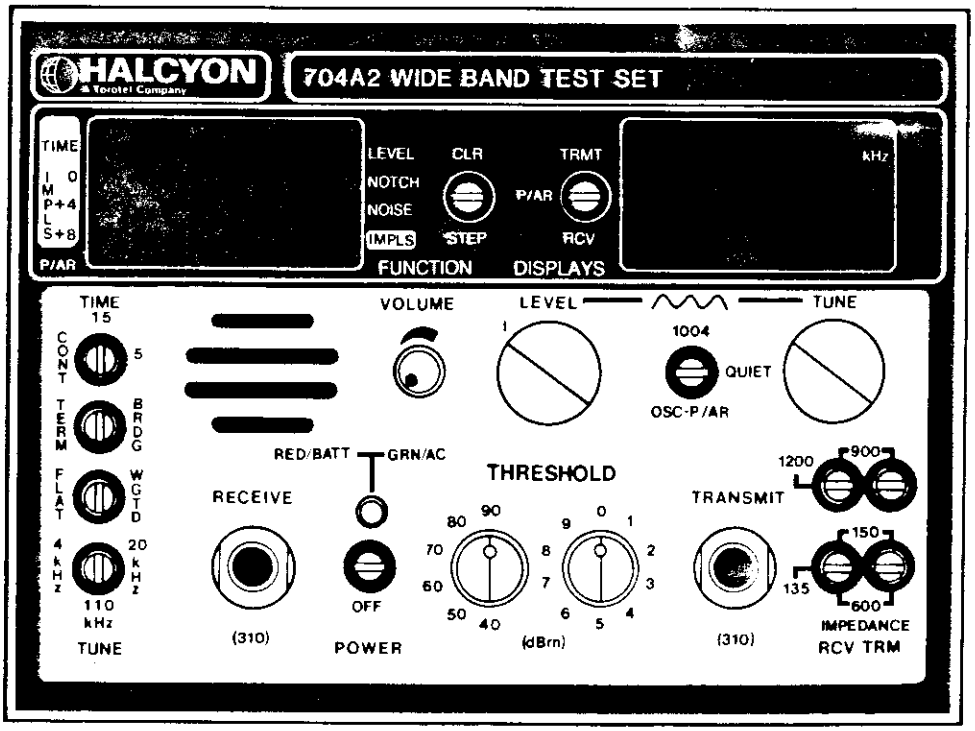


Figure 1. 704A2 Wide Band Test Set

channels. Measurement capabilities include the following parameters:

- Level
- Frequency
- Idle-channel noise
- Noise with tone (notch noise)
- Noise to ground (optional)
- Impulse noise (three levels)
- P/AR

1.05 The 704A2 is designed to test both two-wire and four-wire circuits. On a four-wire circuit the 704A2 can simultaneously transmit and receive test signals. On two-wire (dial-up) circuits the Dial and Hold Unit must be used in conjunction with the 704A2 to seize and hold the circuit(s) under test.

1.06 When using the 704A2 as a transmitter, test signals may be selected and transmitted by the operator. Single frequency signals in a range of 50 Hz to 110 kHz or the complex P/AR signal may be selected and transmitted at a specific level. A quiet termination to be used for noise tests may also be selected.

1.07 When using the 704A2 as a receiver, test measurement circuitry may be selected by the operator. The operator may select level/frequency, notch noise, noise, impulse noise, and P/AR measurement circuitry.

1.08 Separate impedances for the receive and transmit sides of the circuit may be set. Impedances of 135, 150, 600, 900, and 1200 ohms are available; the receive impedance may be either terminated or bridged.

1.09 Six filters may be chosen to weight the received signal. These filters are C-message, 3 kHz flat, program, 15 kHz flat, 50 kbit, and 50 kHz flat. A 1004-Hz notch filter may be enabled for notch-noise measurements.

1.10 The impulse noise threshold may be set at any level between 40 dBrn and 99 dBrn, inclusive; an impulse test duration of 5 minutes, 15 minutes, or continuous may be set.

1.11 A noise-to-ground test may be made using the optional noise-to-ground adapter.

C. Inspection and Warranty

1.12 Standard Warranty. Products manufactured by Halcyon Communications, Inc., are guaranteed to be free of defects in materials and workmanship for a period of one year from the date of shipment. Halcyon will accept returned items, transportation prepaid to the nearest service center, for repair during the warranty period at no cost to the customer, provided that the products have not been subjected to improper installation, accident, misuse, neglect, or unauthorized alterations.

1.13 Certification. Halcyon Communications, Inc., certifies that all instruments are thoroughly tested and inspected and found to meet published specifications when shipped from the factory.

1.14 Inspection. All Halcyon manufactured equipment is carefully inspected and thoroughly tested prior to shipment. Modern packaging techniques are used to prevent damage in shipment.

1.15 If goods are received in a damaged condition, A CLAIM SHOULD BE FILED WITH THE CARRIER IMMEDIATELY. Normally, the carrier will want to inspect the shipping carton and packing materials. A copy of this claim should be forwarded to Halcyon.

1.16 If equipment that has no apparent damage does not operate properly when tested in accordance with the instructions, it should be returned to one of the addresses shown for repair or replacement. Unauthorized field repairs

or modifications may invalidate the warranty.

1.17 When returning equipment for repair, utmost care in packing should be taken to avoid shipping damage. If available, use the original cartons and packing material. Shipping charges should be prepaid.

1.18 Returned equipment that is covered by the warranty will be repaired as expeditiously as possible and shipped prepaid.

1.19 If the equipment is not covered by warranty, a quotation for repair charges will be made first. Repairs will be made after authorization (purchase order) to proceed is received.

1.20 Service Centers. Halcyon service centers are located at the listed addresses. Instruments should be returned to Halcyon, Inc., Customer Service, at the nearest location.

DOMESTIC SERVICE CENTERS

2001 Gateway Place
Suite 201 East
San Jose, CA 95110
(408) 298-2065

2151 Michelson Dr.
Suite 275
Irvine, CA 92715
(714) 851-1057

1000 Main Street
Suite 180
Grapevine, TX 76501
(817) 481-7548

1931 J. Rohlwing Road
Rolling Meadows, IL 60008
(312) 255-3000

Raritan Plaza III, First Floor
Edison, NJ 08837
(201) 225-5350

8375 Dunwoody Place
Atlanta, GA 30338
(404) 998-2210

COMPANY HEADQUARTERS

1 Halcyon Plaza
2121 Zanker Road
San Jose, CA 95131
(408) 293-9970
TWX 910-338-0562

2. SPECIFICATIONS

2.01 The following paragraphs list the specifications for the 704A2.

A. General

2.02 Mechanical

Height	5.05 in (12.7 cm).
Width	7.0 in (17.8 cm).
Depth	12.0 in (30.5 cm).
Weight	12.9 lbs (5.83 kg).

2.03 Environmental

Temperature	0 to 50 degrees C.
Relative Humidity	0 to 95 pct, non-condensing.

2.04 Electrical

Input Voltage	120 or 240 Vac.
Frequency	50-60 Hz.
Power Consumption	25 VA.
Battery Pack	
Operating Time	3.5 hours (typical).
Recharge Time	10 nours (minimum).
Discharge/Recharge Cycles	Virtually unlimited.

2.05 Impedances

Output	135,150,600,900, 1200 ohms.
Input	
Terminated	135,150,600,900 1200 ohms.
Bridged	20 kohms or greater.

B. Transmitter

2.06 Variable Oscillator

Frequency Range	
4 kHz Range	50 Hz to 4 kHz.
20 kHz Range	3 kHz to 20 kHz.
110 kHz Range	15 kHz to 110 kHz.
Output Level Range	+13 dBm to -40 dBm; +10 dBm to -40 dBm @ 1200 ohms.
Output Level Accuracy	+/-0.1 dB, 200 Hz to 4000 Hz; +/-0.2 dB, 4 kHz to 15 kHz; +/-0.5 dB, 15 kHz to 110 kHz.
Distortion	<-50 dB @ 300 Hz to 3000 Hz. <-40 dB @ 50 Hz to 110 kHz. <-60 dB @ 1004 Hz.

2.07 P/AR Signal Source

P/AR Line Spectrum	Per Tables J & K PUB 41009.
Output Level Range	0 dBm to -39 dBm.
Output Level Accuracy	+/-1.0 dB
Output Level Resolution	1.0-dB increments.

C. Receiver

2.08 Level Measurement

Level Range	-50 dBm to +13 dBm.
Frequency Range	50 Hz to 110 kHz.
Level Accuracy	
-30 dBm to +8 dBm	+/-0.1 dB @ 1 kHz. +/-0.2 dB @ 200 Hz to 15 kHz. +/-0.5 dB @ all other frequencies.
All Other Levels	+/-0.3 dB @ 200 Hz to 15 kHz. +/-0.5 dB @ all other frequencies.
Level Resolution	0.1 dB.
Detector Type	Average.

2.09 Noise Measurement

Level Range	
Idle Channel	10 dBrn to 99 dBrn.
Notched	20 dBrn to 99 dBrn.
Frequency Range	Weighting-network dependent.
Weighting Networks	
4 kHz	C-message and 3 kHz.
20 kHz	Program and 15 kHz.
110 kHz	50 kbit and 50 kHz.
Level Accuracy	+/-1 dB @ 20 dBrn to 99 dBrn. +/-2 dB below 20 dBrn.
Level Resolution	1 dB.

Notch Filter Attenuation	50 dB or more @ 995 Hz to 1025 Hz.
Detector Type	Quasi-rms.

2.10 Frequency Measurement

Level Range	-50 dBm to +13 dBm.
Frequency Range	50 Hz to 110 kHz.
Frequency Accuracy	+/-1.0 Hz, 4 kHz range. +/-10.0 Hz, other ranges.
Resolution	1 Hz, 4 kHz range. 10 Hz, other ranges.

2.11 Impulse Noise Measurement

Threshold Range

1st Threshold	40 dBrn to 99 dBrn, 1 dB steps.
2nd Threshold	+4 dB relative to 1st.
3rd Threshold	+8 dB relative to 1st.
Threshold Accuracy	+/-1.0 dB.
Threshold Resolution	1 dB.
Test Durations	5 min, 15 min, continuous.
Count Capacity	999.

2.12 Noise-to-Ground Measurements

Measurement Range	50 dBrn to 130 dBrn.
Measurement Accuracy	+/-1.5 dB.
Ring-to-Ground Impedance	100 kohms.
Tip-to-Ground Impedance	100 kohms.

2.13 P/AR Measurement

Measurement Range	0 - 120 P/AR units.
Measurement Accuracy	+/-2 P/AR units, 30 to 110; +/-4 P/AR units, 0 to 30 and 110 to 130.
Measurement Resolution	1 P/AR unit.

3. OPTIONS AND ACCESSORIES

3.01 The following paragraphs describe the options and accessories that are available for the 704A2 Wide Band Test Set. Part numbers are identified in parenthesis.

3.02 Padded Lightweight Field Case. A molded plastic, padded, lightweight field case (1403-0002-20) provides limited protection for the 704A2 during transit.

3.03 Heavy-duty Shipping Trunk. A fiber glass heavy-duty shipping trunk (1403-0002-00) provides protection for the 704A2 during shipping.

3.04 Noise-to-Ground Adapter. Plugging this adapter (8220-0003-90) into the RECEIVE jack of the 704A2 permits the measurement of noise-to-ground levels.

4. INSTALLATION AND INTERCONNECTION

4.01 The 704A2 is designed as a lightweight, portable unit; therefore, no installation is required.

4.02 The 704A2 can be operated from an ac power source or from the internal battery pack:

(a) AC Source: The 704A2 is set at the factory for an operating voltage of 120 volts. If the 704A2 is

to be operated at 240 volts, open the small window in the rear panel of the 704A2 by sliding it to the left to expose the fuse and voltage selector card. A lever marked FUSE PULL releases the fuse. Pull out the card with either needle-nose pliers or by inserting a pointed tool into the small hole at the card's edge. Orient the card so that 240 reads right side up. Re-insert the card along with a correctly rated fuse. When plugged into an ac outlet and turned on, the 704A2 will operate from the ac power source.

(b) Battery Pack: When not plugged into an ac outlet but turned on, the 704A2 will operate from the battery pack. Typical operating time when using batteries is 3.5 hours. Batteries recharge in approximately 10 hours when the 704A2 is plugged in but turned off.

4.03 Instructions on connecting test circuits to the 704A2 are given in paragraphs 6.06 and 6.07.

5. CONTROLS AND INDICATORS

5.01 The following paragraphs describe the front panel controls and indicators of the 704A2. (See figure 3.)

A. Toggle Switches

5.02 POWER. Two-position toggle switch that controls power to the 704A2.

5.03 TIME. Three-position toggle switch that selects the duration of the impulse-noise test. Positions are provided for 5-minute, 15-minute, or continuous test durations.

5.04 TERM/BRDG. Two-position toggle switch that selects either a bridging or terminating impedance for the circuit under test. The TERM/BRDG switch affects the RECEIVE input jack only.

5.05 FLAT/WGTD. Two-position toggle switch that selects either a flat or weighted filter for measuring noise. The FLAT/WGTD switch affects the RECEIVE input jack only.

5.06 TUNE (4/20/110 kHz). Three position toggle switch that selects the frequency range of the oscillator and receive filter.

5.07 TRMT, P/AR, RCV (display switch). Three-position toggle switch that selects whether the displays monitor the transmitted or received signal. When the switch is in the P/AR position, the display indicates the P/AR units of the received P/AR signal.

5.08 CLR/STEP. Center-return-off toggle switch. Pushing this switch to the STEP position toggles the function display's LEDs through the test modes. Pushing this switch to the CLR position clears the impulse count registers, resets the impulse test's elapsed time to zero, and restarts the impulse noise test.

5.09 1004/QUIET/OSC-P/AR (oscillator switch). Three-position toggle switch that selects the 1004-Hz signal, the quiet termination, or the variable frequency, P/AR oscillator.

5.10 IMPEDANCE. Four three-position toggle switches that select the terminating impedance of the TRANSMIT and RECEIVE jacks. The two left-hand switches determine the impedance for the receive circuit; the right-hand switches determine the impedance for the transmit circuit. The impedance is set as follows:

IMPEDANCE	UPPER SWITCH POSITION	LOWER SWITCH POSITION
900 ohms	900	Don't Care
1200 ohms	1200	Don't Care
150 ohms	Down Position	150
135 ohms	Down Position	135
600 ohms	Down Position	600

B. Potentiometers (knobs)

5.11 LEVEL. Controls the output level of the transmitted signal. To monitor the transmitted level, the display switch must be in the TRMT position and the LEVEL or P/AR LEDs must be lit. The LEVEL control has no effect when the oscillator switch is set to QUIET.

5.12 TUNE. Controls the frequency of the transmitted signal. This control is active only when the oscillator switch is in the OSC-P/AR position and the LEVEL LED is lit. To monitor the transmitted frequency, the display switch must be in the TRMT position.

5.13 VOLUME. Controls the volume of the speaker. The speaker monitors the transmitted or received signal depending upon the position of the display switch.

5.14 THRESHOLD. Two potentiometers that control the threshold level for the impulse-noise measurements. The two potentiometers permit settings in the range of 40 dBrn to 90 dBrn in 1-dB steps.

C. Jacks

5.15 RECEIVE. A 310 jack to which a test circuit is connected for the measurement of received test signals.

5.16 TRANSMIT. A 310 jack to which a test circuit is connected for the transmission of test signals.

D. Displays

5.17 The frequency (right-hand) display indicates the frequency of the transmitted or received signal, depending upon the position of the display switch.

5.18 The function (left-hand) display monitors the level of the transmitted signal or displays the test measurements of the received signal.

5.19 Power LED. The LED lights when the POWER toggle switch is in the up (on) position. The LED is green when the 704A2 is operating from an ac supply; red when operating from battery. The red LED flashes when the battery is discharged to below acceptable levels.

6. OPERATING PROCEDURES

A. General Testing Information

6.01 Before beginning the testing of a circuit, the appropriate system practice or system testing procedure should be reviewed and used as the primary guideline in performing the desired tests. In addition, circuit design records provide information on circuit impedance and transmission level point (TLP) values.

6.02 It is particularly important, when performing analog testing, that the transmit level is properly adjusted. An excessive output level, in addition to causing measurement error, can result in transmission impairment to potentially hundreds of other circuits being transmitted over the facility carrying the circuit under test. Normal test practices call for a test level of -13 dBm0.

6.03 Send and receive levels are indicated on the 704A2 display in dBm (for signals) and dBrn (for noise). Many test practices, however, call for levels in dBm0 or dBrn0; that is, power relative to the zero transmission level point (TLP):

(a) TLP. The absolute level of test signals is determined relative to an arbitrary point on the circuit called the OTLP (zero transmission level point). Current telephone testing practices call for the test level at the OTLP to be -13 dBm. The absolute level for test signals at other points on the circuit can be determined by adding the TLP value to -13 dBm. For example, to determine the correct absolute test signal level

in dBm at the 3TLP, add 3 to -13 dBm. (-13 + 3 = -10 dBm). Thus the test level at the 3TLP is -10 dBm.

(b) dBm0 and dBrn0. Test practices often call for absolute power levels in dBm and dBrn to be converted to dBm0 and dBrn0, respectively. A reading in dBm may be converted to dBm0 by subtracting the TLP from the dBm reading. For example, a measurement of -16 dBm taken at the 3TLP is equal to -19 dBm0 (-16 - 3 = -19 dBm0). Follow the same procedure to convert dBrn to dBrn0.

6.04 Impedances. Test practices specify the characteristic impedance of the circuit under test. It is important that the 704A2's impedance setting match this characteristic circuit impedance. When using the 704A2 to transmit, simply set the TRMT IMPEDANCE switches to the impedance of the circuit; in this case it does not matter in which position the TERM/BRDG switch is set. When using the 704A2 to receive and measure test signals, set the RCV IMPEDANCE switches to the impedance of the circuit; then, if the circuit is already terminated by other equipment, set the TERM/BRDG switch to BRDG; if the circuit is not already terminated, set the TERM/BRDG switch to TERM.

B. Preliminary Setup

6.05 To set up the 704A2 for testing, perform the following steps:

(a) Set the IMPEDANCE switches for the characteristic impedance of the circuit(s) under test. Note that the receive impedance and the transmit impedance may be set independently of each other.

(b) Set the TERM/BRDG switch for a terminating or bridging impedance. (See paragrapn 6.04 for a detailed explanation of impedance setting.)

(c) Turn on power to the 704A2 by pushing the POWER switch to the on (up) position. The POWER LED will be green. (If the 704A2 is not connected to an ac power source, the POWER LED will be red. If the battery is discharged to below acceptable levels, the red LED will flash.)

(d) Set the oscillator switch to the QUIET position.

C. Circuit Connection

6.06 If performing tests on dedicated circuit(s), simply plug the circuit(s) into the front panel jack(s). Plug the circuit over which the 704A2 will transmit into the TRANSMIT jack; plug the circuit over which the 704A2 will receive into the RECEIVE jack.

6.07 If performing tests on dial-up circuits, the 705A Dial and Hold Unit must be used. Using patch cables, connect the TRANSMIT jack on the 704A2 to the TRANSMIT jack on the 705A; connect the RECEIVE jack on the 704A2 to the RCV jack on the 705A. Perform the instructions given with the 705A to establish a connection with the far-end 705A. The 705A also includes instructions on transposing the transmit and receive functions by using the XFR/NORM switch.

D. Test Procedures

6.08 The following test procedures refer to end-to-end circuit testing using a 704A2 at both the near-end and far-end test sites. The 704A2 may also be used in loop-around tests where both ends of a circuit are available at the same test site; in this case the 704A2 may simultaneously transmit and receive on the same circuit. Other compatible test equipment may be used in place of one of the 704A2s to act as either signal-source or measurement equipment. Refer to figure 3 (located at the rear of this manual) for the location of 704A2 controls and indicators.

6.09 Level Test. The level test requires the transmission of a 1004-Hz signal at one end of the circuit

at the specified data test level and the measurement of tne level of this signal at the other end.

(a) Transmitting. To transmit the 1004-Hz signal, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the TUNE toggle switch to 4 kHz.

(4) Set the oscillator switch to 1004.

(5) Verify that the frequency display indicates 1.004 kHz.

(6) Using the LEVEL knob, adjust the level to that specified in the system practice.

(7) Notify the far-end that 1004 Hz is being transmitted at the required level.

(b) Receiving. To receive and measure the 1004-Hz signal, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to RCV.

(3) Set the TUNE toggle switch to 4 kHz.

(4) Request the far-end to transmit 1004 Hz at the specified level.

(5) Record the level shown on the display in dBm. If required by the system practice, convert this level in dBm to dBm0 by using the procedure given in paragraph 6.03.

6.10 Attenuation Distortion Test. The attenuation distortion test requires the transmission of a series of test frequencies at the specified test level at one end of the circuit and the measurement of the level of these signals at the other end.

(a) Transmitting. To transmit the attenuation distortion signals, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the oscillator switch to OSC-P/AR.

(4) Set the TUNE toggle switch to the range of the signal to be transmitted.

(5) Using the TUNE knob, adjust the signal to the frequency specified in the system practice.

(6) Using the LEVEL knob, adjust the level to that specified in the system practice.

(7) Notify the far-end that the test signal is being sent at the specified frequency and level.

(8) In close coordination with the far-end, perform steps (4) thru (7) for each of the signals specified in the system practice. Pause at each frequency long enough for the far-end operator to reach and record the respective level measurement.

(b) Receiving. To receive and measure the attenuation distortion signals, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to RCV.

(3) Set the TUNE switch to the range of the transmitted signal.

(4) Record the level shown on the display in dBm. Attenuation

distortion is calculated as the difference in level between a given frequency and the level of the reference frequency of 1004 Hz. To calculate attenuation distortion, perform the following steps:

(i) Calculate the absolute difference between the level of the test signal and the level of the 1004-Hz signal. For example:

FREQUENCY	LEVEL	DIFFERENCE
1004 Hz (ref)	-16dBm	0dB
404 Hz	-20dBm	4dB
2804 Hz	-22dBm	6dB

(ii) Express the difference calculated in step (i) as a plus or minus dB value, depending upon the requirements of the system practice used. Some practices require that more loss than the reference level be expressed as a positive value, while less loss be expressed as a negative value. For example, using the data from step (i), the difference values would be positive because the test levels (-20 dBm and -22 dBm) indicate more loss than the reference level (-16 dBm). Other practices require that more loss than the reference level be expressed as a negative value, while less loss be expressed as a positive value. For example, using the data from step (i), the difference values would be negative because the test levels indicate more loss than the reference level.

(5) Request the far-end to transmit each signal specified in the system practice, pausing at each frequency long enough to read and record the measurement.

6.11 P/AR (peak-to-average ratio) Test. The P/AR Test requires the transmission of the P/AR signal at one end of the circuit and the measurement of the signal (in P/AR units) at the other end.

(a) Transmitting. To transmit the P/AR signal, perform the following steps:

(1) Using the CLR/STEP switch, light the P/AR LED.

(2) Set the display switch to TRMT.

(3) Set the oscillator switch to OSC-P/AR.

(4) Adjust the signal level (using the LEVEL knob) to the level specified in the system practice.

(5) Notify the far-end that the P/AR signal is being sent at the required level.

(b) Receiving. To receive and measure the P/AR signal, perform the following steps:

(1) Using the CLR/STEP switch, light the P/AR LED.

(2) Set the display switch to P/AR.

(3) Request the far-end to transmit the P/AR signal at the specified level.

(4) Record the P/AR value shown on the display in P/AR units.

NOTE: During the P/AR test, the display will blank showing a plus sign if the level of the received signal is over range, and showing a minus sign if the level is under range.

6.12 Idle-Channel Noise Test. The idle-channel noise test requires the quiet termination of the circuit at one end and the measurement of the noise level present at the other end.

(a) Transmitting. To quiet-terminate the circuit, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(7) Read and record the noise-with-tone level. This is the 3 kHz flat noise level given in dBrn. To convert the dBrn level to dBrn0, see paragraph 6.03.

6.14 Signal-to-Noise Ratio Test. The signal-to-noise ratio test requires the transmission of a 1004-Hz signal and the measurement of the signal level through the unnotched filter. It then requires that the difference between this reading and the notch-noise reading be calculated.

(a) Transmitting. To transmit the 1004-Hz signal, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the TUNE toggle switch to 4 kHz.

(4) Set the oscillator switch to 1004.

(5) Verify that the frequency display indicates 1.004 kHz.

(6) Using the LEVEL knob, adjust the level to that specified in the system practice.

(7) Notify the far-end that 1004 Hz is being transmitted at the required level.

(b) Receiving. To receive and measure the signal-plus-noise level, perform the following steps:

(1) Using the CLR/STEP switch, light the NOISE LED.

(2) Set the display switch to RCV.

(3) Set the TUNE toggle switch to 4 kHz.

(4) Set the FLAT/WGHT switch to WGHT.

(5) Read and record the signal-plus-noise level. This is the level expressed in dBrn through the C-message filter.

(6) Set the FLAT/WGHT switch to FLAT.

(7) Read and record the signal-plus-noise level. This is the level expressed in dBrn through the 3 kHz filter.

(8) To calculate the signal-to-noise ratio, perform the following steps:

(i) Subtract the C-message notch-noise reading in dBrn (obtained in the notch-noise test, paragraph 6.13, step b-5) from the unnotched reading (obtained in paragraph 6.14, step b-5). The difference between the two readings is the C-message signal-to-noise ratio.

(ii) Subtract the 3 kHz notch-noise reading in dBrn (obtained in the notch-noise test, paragraph 6.13, step b-7) from the unnotched reading (obtained in paragraph 6.14, step b-7). The difference between the two readings is the 3 kHz signal-to-noise ratio.

6.15 Impulse Noise Test. The impulse noise test requires either the transmission of 1004 Hz or the quiet termination of the line at one end of the circuit. Three levels of impulse noise are measured at the other end of the circuit.

(a) Transmitting (1004 Hz). To transmit the 1004-Hz signal, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the oscillator switch to QUIET. (The display will blank, except for a minus sign and decimal point.)

(4) Notify the far-end that the circuit has been quiet-terminated.

(b) Receiving. To measure idle-channel noise, perform the following steps:

(1) Using the CLR/STEP switch, light the NOISE LED.

(2) Set the display switch to RCV.

(3) Use the TUNE toggle switch and the FLAT/WGTD toggle switch to select the filter networks required for the type of circuit (VF, program, wideband) under test. The following table gives the switch positions, filter types, and circuit types:

TUNE SWITCH POSITION	FLAT/ WGHT SWITCH POSITION	FILTER TYPE	CIRCUIT TYPE
4 kHz	WGHT	C-message	VF
4 kHz	FLAT	3 kHz	VF
20 kHz	WGHT	Program	Program
20 kHz	FLAT	15 kHz	Program
110 kHz	WGHT	50 kbit	Wideband
110 kHz	FLAT	50 kHz	Wideband

(4) Read and record the idle-channel noise level through both filters listed for the circuit type under test. Level is given in dBrn. To convert the dBrn level to dBrn0, see paragraph 6.03.

NOTE: The idle-channel noise measurement yields erroneous results on telephone circuits containing compandered facilities; therefore, the noise-with-tone test (see paragraph 6.13) is usually specified as the required measurement on this kind of facility.

6.13 Noise with Tone Test (Notch Noise). The noise-with-tone test requires the transmission of a 1004-Hz signal and the measurement of noise on the circuit with the signal notched out.

(a) Transmitting. To transmit the 1004-Hz signal, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the TUNE toggle switch to 4 kHz.

(4) Set the oscillator switch to 1004.

(5) Verify that the frequency display indicates 1.004 kHz.

(6) Using the LEVEL knob, adjust the level to that given in the system practice.

(7) Notify the far-end that 1004 Hz is being transmitted at the required level.

(b) Receiving. To receive and measure the noise-with-tone signal, perform the following steps:

(1) Using the CLR/STEP switch, light the NOTCH LED.

(2) Set the display switch to RCV.

(3) Set the TUNE toggle switch to 4 kHz.

(4) Set the FLAT/WGHT switch to WGHT.

(5) Read and record the noise-with-tone level. This is the C-message level expressed in dBrn. To convert the dBrn level to dBrn0, see paragraph 6.03.

(6) Set the FLAT/WGHT switch to FLAT.

(2) Set the display switch to TRMT.

(3) Set the TUNE toggle switch to 1004.

(4) Set the oscillator switch to 1004.

(5) Verify that the frequency display indicates 1.004 kHz.

(6) Using the LEVEL knob, adjust the level to that specified in the system practice.

(7) Notify the far-end that 1004-Hz is being transmitted at the required level.

(b) Transmitting (quiet termination). To quiet-terminate the circuit, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the oscillator switch to QUIET. (The display blanks except for a minus sign and decimal point.)

(4) Notify the far-end that the circuit has been quiet-terminated.

(c) Receiving. To receive and measure impulse noise, perform the following steps:

(1) Using the THRESHOLD knob, set the impulse test threshold in dBrn to that specified in the test practice.

(2) Set the FLAT/WGTD switch to WGTD.

(3) Set the TUNE toggle switch to the frequency range of the circuit under test.

(4) Set the TIME toggle switch to the duration required for the impulse noise test.

(5) Request the far-end to transmit 1004 Hz at the specified level, or request the line to be quiet terminated.

(6) Using the CLR/STEP switch, light the IMPLS LED. (The IMPLS LED flashes and the TIME LED comes on.)

(7) Press the CLR/STEP switch to CLR to clear the display, reset the timer, and begin the test. During the test, the occurrence of impulse noise flashes the LEDs of the appropriate level (0, +4, +8). Elapsed time is indicated on the function display. When the test time elapses, the process stops and the IMPLS LED goes off.

(8) Using the CLR/STEP switch, light the 0, +4, and +8 LEDs in turn. As each LED is lit, the display indicates the impulse count at each level. (During this process, be careful not to press the CLR/STEP switch to CLR.)

NOTE: This display, showing elapsed test time will blank if the impulse threshold is set too low relative to the level of the received 1004-Hz signal.

6.16 Noise-to-Ground Test. This measurement requires the use of the optional noise-to-ground adapter (part number 8220-0003-90). This measurement determines the magnitude of longitudinal (common-mode) voltages existing between the tip-ring circuit pair and ground. It requires the quiet termination of the line at one end and the measurement of noise relative to ground at the other end.

(a) Transmitting. To quiet-terminate the circuit, perform the following steps:

(1) Using the CLR/STEP switch, light the LEVEL LED.

(2) Set the display switch to TRMT.

(3) Set the oscillator switch to QUIET.

(4) Notify the far-end that the circuit has been quiet terminated.

NOTE: The noise-to-ground adapter permits terminating impedances of 600 and 900 ohms only. Therefore, this test is applicable only to circuits with those characteristic impedances.

(b) Receiving. To measure noise-to ground, perform the following steps:

(1) Using the CLR/STEP switch, light the NOISE LED.

(2) Set the display switch to RCV.

(3) Set the IMPEDANCE switch to the impedance of the line under test.

NOTE: The noise-to-ground adapter permits terminating impedances of 600 and 900 ohms only. Therefore, this test is applicable only to circuits with those characteristic impedances.

(4) Set the TERM/BRGD switch to BRDG.

(5) Set the TUNE toggle switch to 4 kHz.

(6) The FLAT/WGTD switch may be used in either position. The FLAT position is useful in detecting low-frequency noise, such as power-line induction.

(7) Plug the noise-to-ground adapter into the RECEIVE jack. (See figure 2.)

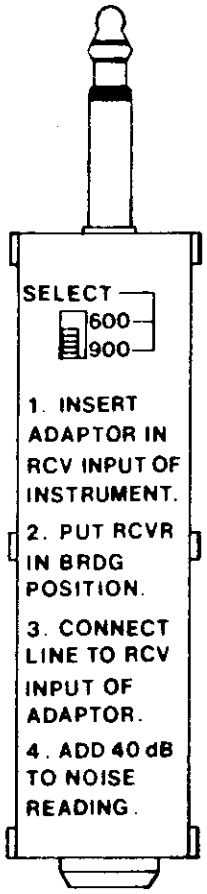


Figure 2. Noise-to-Ground Adapter

(8) Set the impedance switch on the adapter to match the impedance selected in step (3).

(9) Plug the circuit under test into the input jack of the adapter.

(10) Add 40 dB to the displayed reading to determine the noise-to-ground measurement in dBrn.

7. OPERATING FLOWCHARTS

7.01 The following paragraphs provide an operating flowchart for the 704A2 Wide Band Test Set.

A. Content

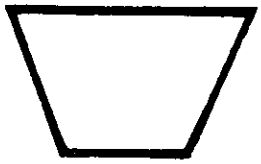
7.02 The content of the flowchart is as follows:

CHART	CONTENT
1	Executive routine
2	Level
3	Attenuation distortion
4	P/AR
5	Idle-channel noise
6	Noise with tone
7	Signal-to-noise ratio
8	Impulse noise
9	Noise to ground

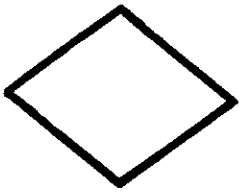
B. Symbology

7.03 The following symbols are used in the flowchart:

Start/End;
Subroutine/Return
from subroutine.



—Operator action.



—Operator decision.

—Go to subroutine.

—Go to.

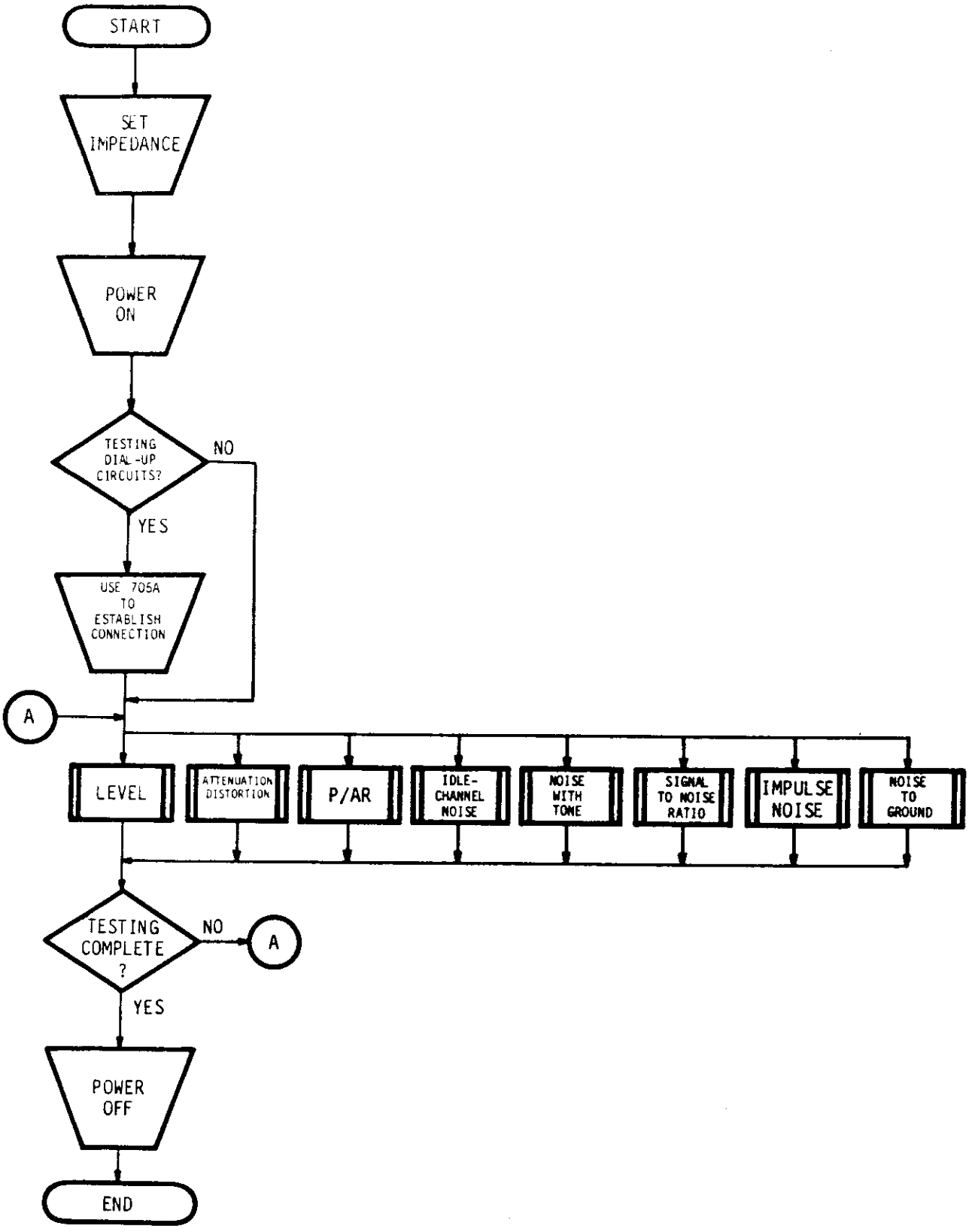


Chart 1. Executive Routine

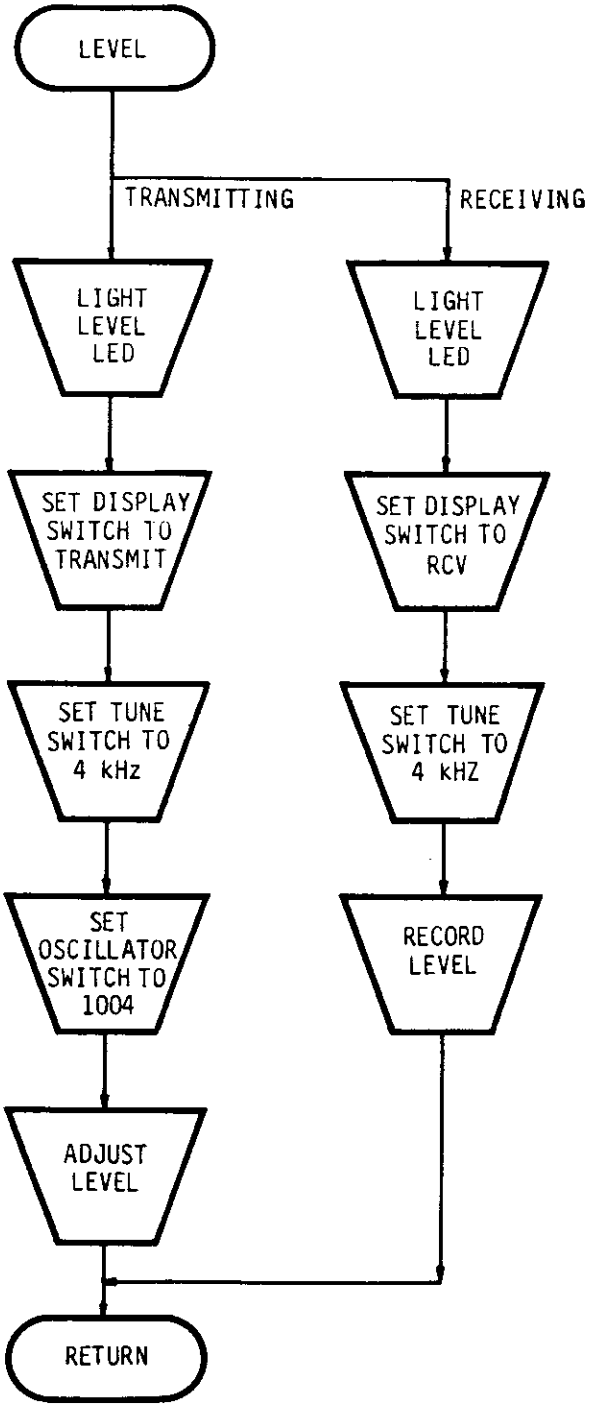


Chart 2. Level

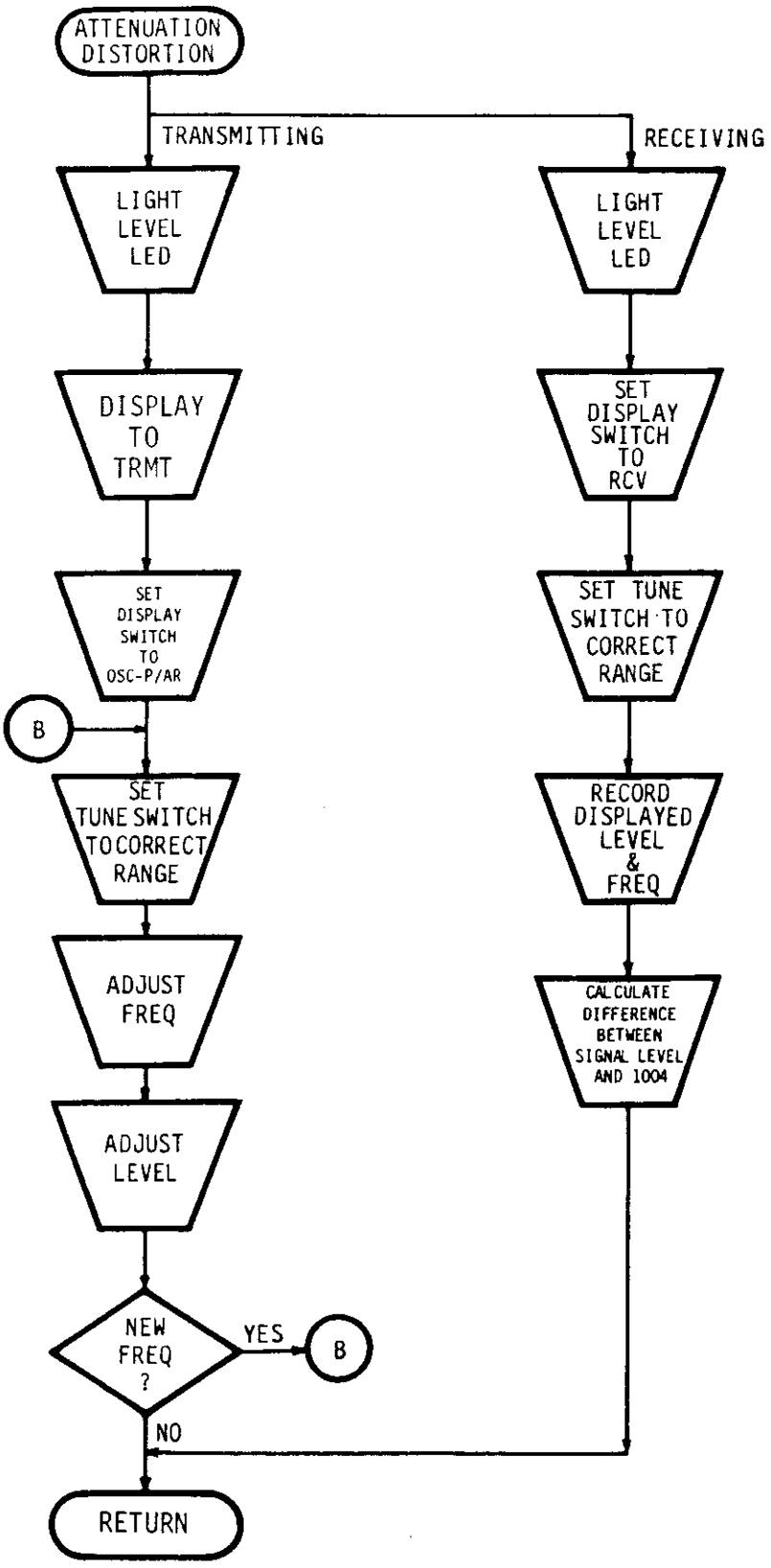


Chart 3. Attenuation Distortion

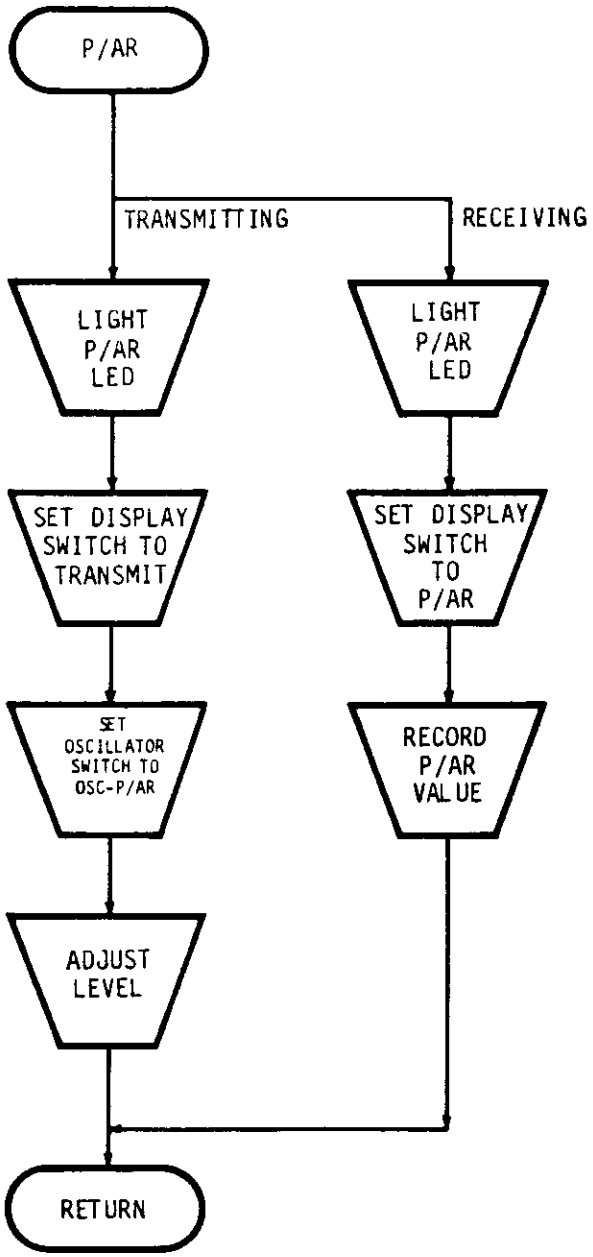

P/AR
TRANSMITTING
RECEIVING
LIGHT P/AR LED
LIGHT P/AR LED
SET DISPLAY SWITCH TO TRANSMIT
SET DISPLAY SWITCH TO P/AR
SET OSCILLATOR SWITCH TO OSC-P/AR
RECORD P/AR VALUE
ADJUST LEVEL
RETURN

Chart 4. P/AR

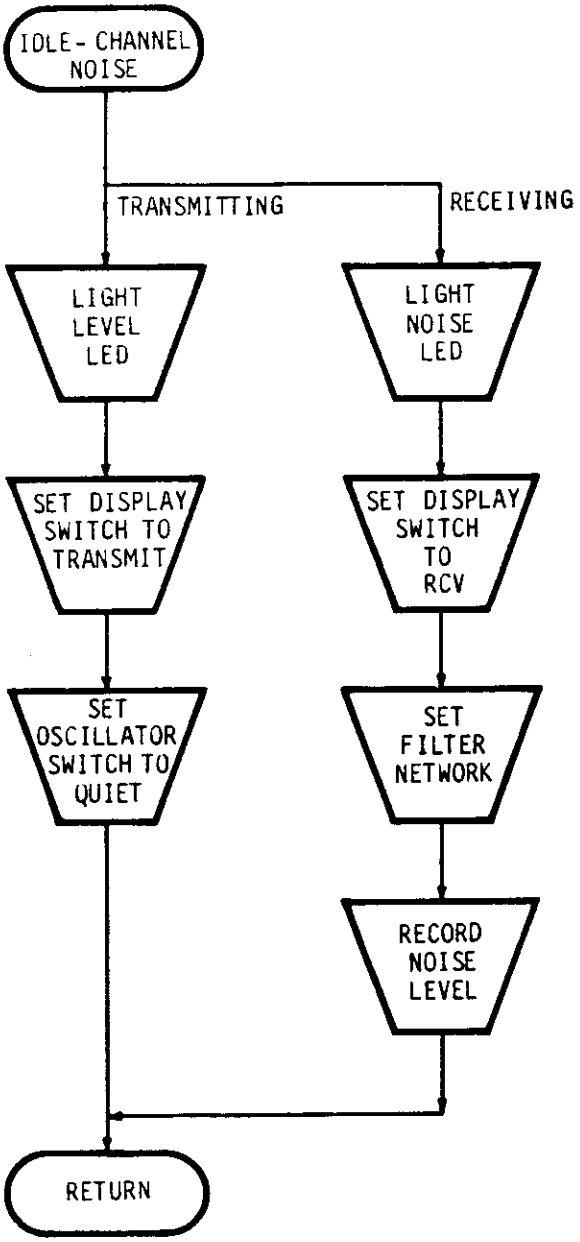


Chart 5. Idle-Channel Noise

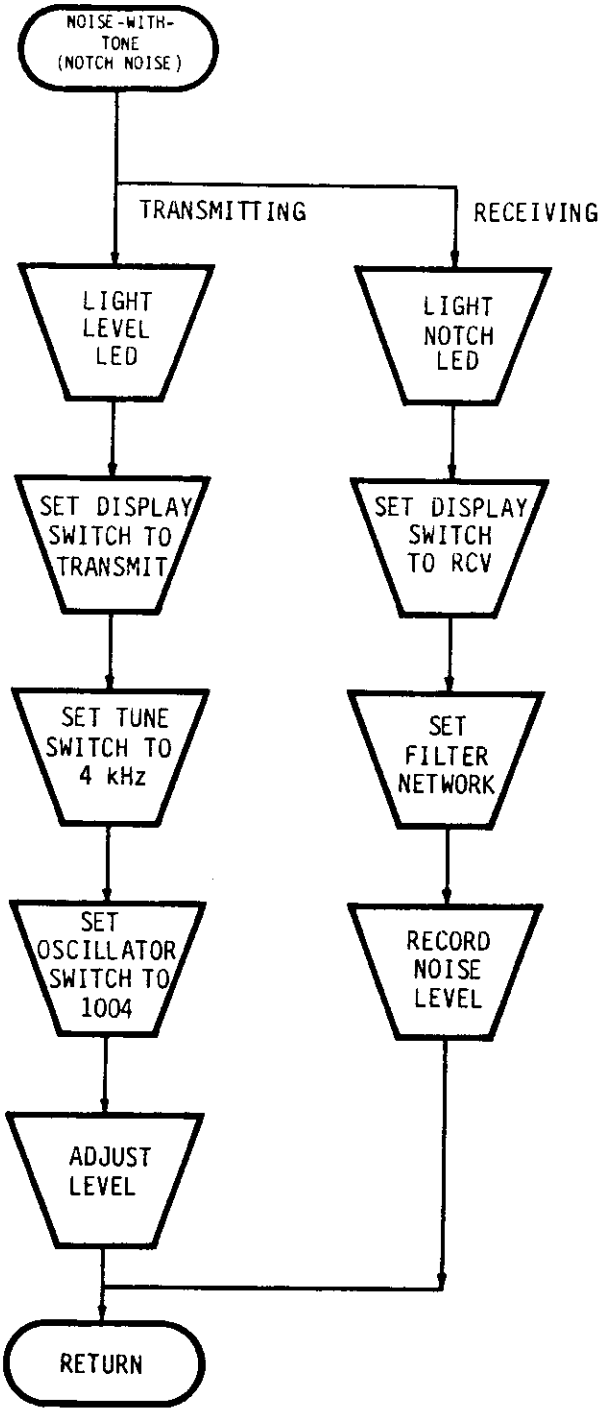


Chart 6. Noise with Tone

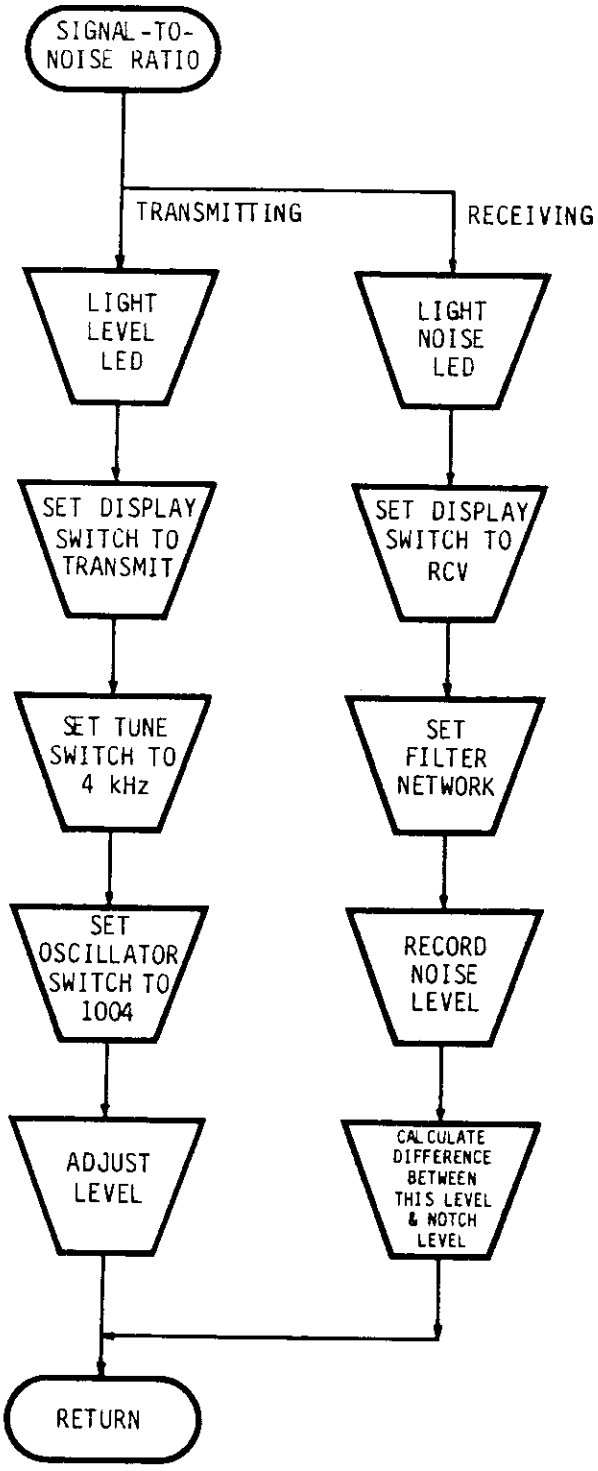


Chart 7. Signal-to-Noise Ratio

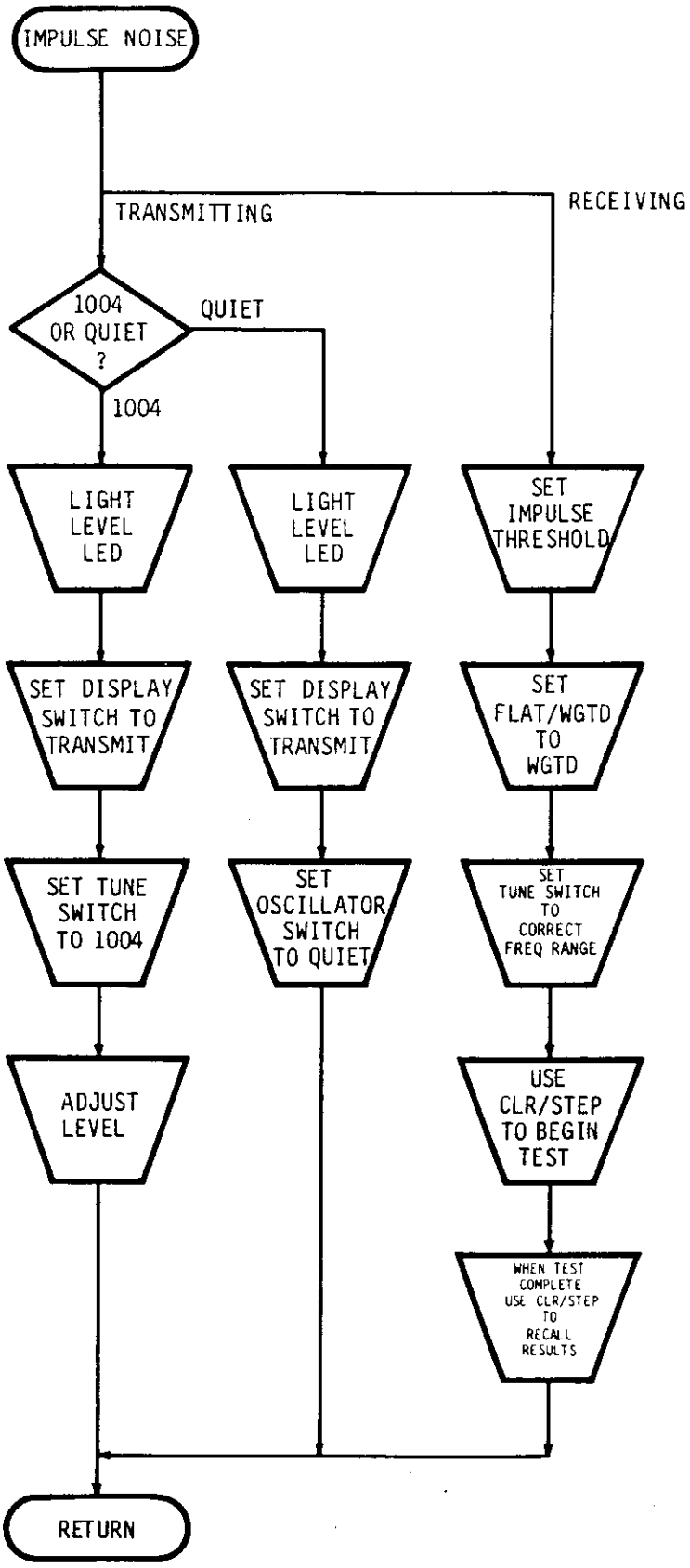


Chart 8. Impulse Noise

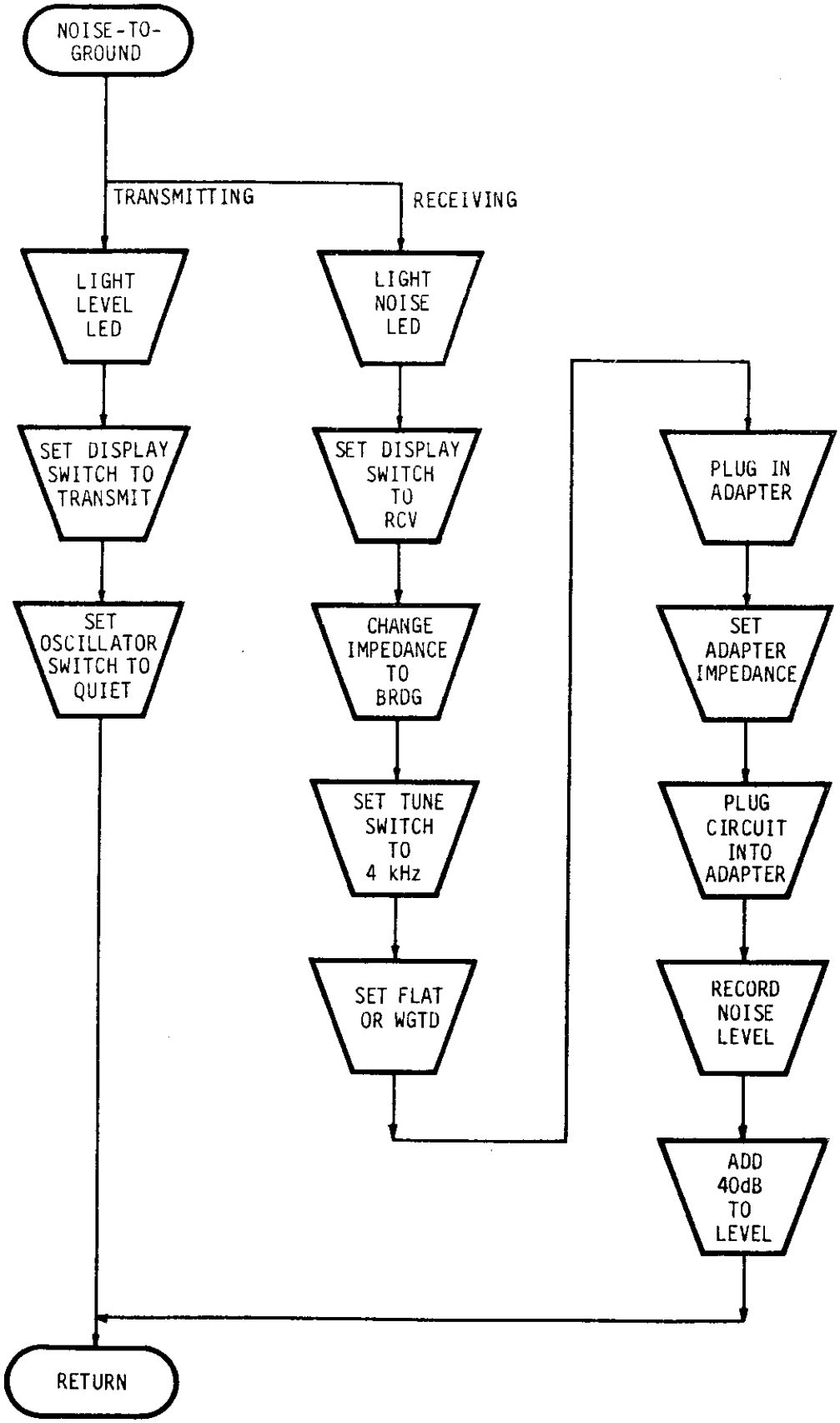


Chart 9. Noise to Ground

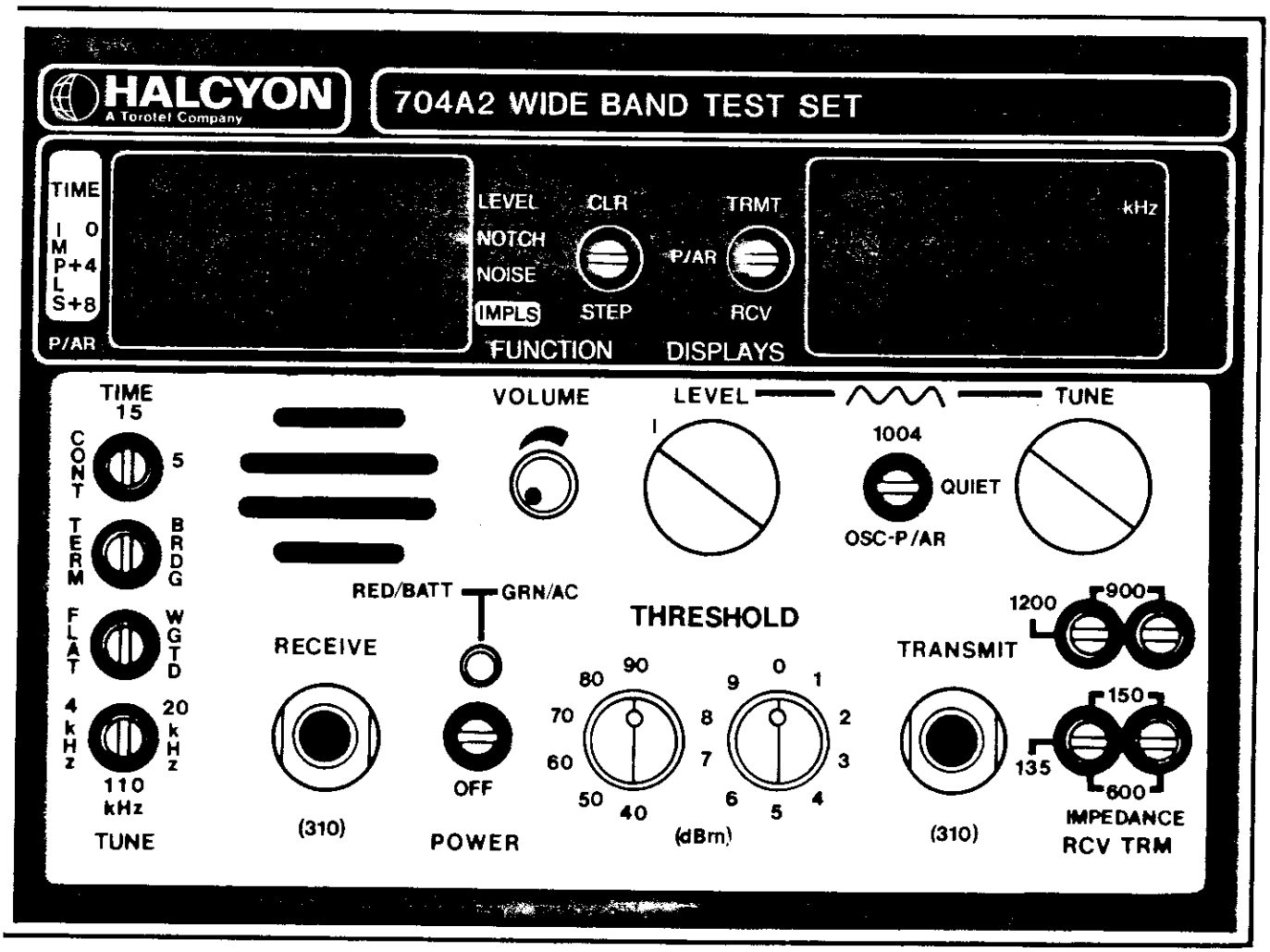


Figure 3. 704A2 Front Panel Controls