

INSTRUCTION MANUAL

FOR

MODEL 905

CAPACITANCE TEST INSTRUMENT

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INSTRUCTION MANUAL NUMBER

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SECTION I SPECIFICATIONS

1.1 ENVIRONMENTAL

Operating Temperature Limits.....20 to 120 ° F
Storage Temperature Limits.....-20 to 140 ° F
Calibration Temperature Coefficient..... $\pm 1\%/100\text{ }^\circ\text{F}$
Vibration Limits..... $\pm 2g$'s to 100 cps

1.2 ELECTRICAL

Supply Voltage.....22.5 VDC Internal Battery
Battery Life.....10 Hours of Intermittent Operation
Output Capacitance Range.....40 pf to 1600 pf
Input Capacitance Range.....0 to 3000 pf maximum
Input Meter Jack.....4-20 ma DC
Meter Resistance.....10.3 ohms $\pm 5\%$

1.3 PERFORMANCE

Meter Accuracy..... $\pm 2\%$ of full scale reading
Input Measurement Linearity:
0-300 pf.....0.5%
300-3000 pf.....0.75%

SECTION II OPERATION

2.1 DESCRIPTION

The Capacitance Test Instrument is a battery operated unit that can measure up to 3000 pf of capacitance and also provide an output capacitance of 40 to 1600 pf. In addition, the meter can be used for a 4 to 20 ma current measurement by utilizing the meter phone jack.

The capacitance input and output connection is accomplished by means of a BNC receptacle marked "C IN/OUT." A low capacitance test lead is provided with unit with the BNC termination. Additional cables are provided when using the meter as a 4 to 20 milliamp measuring device.

2.2 OPERATING CONTROLS

Operation Controls for the following functions are provided:

ON: A momentary switch which, when depressed, provides power to the capacitance measuring circuits.

BATT: A momentary switch which, when depressed, provides information on when to replace the battery.

SEND: When depressed, allows unit to provide an output capacitance as selected on front panel.

PUSH TO READ: Allows unit to measure the output capacitance selected, including the cable capacitance.

ZERO: Allows for zeroing out the cable capacitance before measuring an unknown capacitance.

CABLE COMP: A precalibrated capacitance used to simulate the capacitance of the 6-inch BNC Test Lead and internal circuit so meter indicates correct output capacitance.

RANGE (PF): 5 interlocking positions select the full scale range of the meter dial for input capacitance measurements.

OUTPUT CAPACITANCE (PF): 5 values that can be added together to provide output capacitance up to 1600 pf.

OUTPUT VERNIER: Used in conjunction with the output capacitance pushbuttons selected to adjust output to desired capacitance value.

2.3 OPERATION

NOTE

In all tests and calibration that follow, remove your hands from vicinity of cables after making connections. Your body has a dielectric value which will affect results.

2.3.1 Instrument Calibration

2.3.1.1 For Measurement of Input Capacitance

- Connect BNC Test Lead to "C IN/OUT" receptacle.
- Select the 30 pf range. Depress "BATT" switch to make sure battery is okay, then depress "ON" switch. Making sure pointer is above zero on meter dial, adjust "ZERO" until meter pointer is on zero.

2.3.1.2 For Measurement of Output Capacitance (Send Mode)

- Make sure all "OUTPUT CAPACITANCE" pushbuttons are out and adjust "OUTPUT VERNIER" to minimum.
- Select the 30 pf range and depress "ON" switch. Make sure pointer is above zero on meter dial and then adjust "ZERO" clockwise until meter pointer is on zero.

NOTE

A precalibrated cable compensation allows the adjustment for minimum internal capacitance as determined by the calibration procedure.

2.3.2 Measurement of Input Capacitance

- Connect the BNC Test Cable to the "C IN/OUT" receptacle and calibrate per paragraph 2.3.1.1 above.
- Connect the cable alligator clips to the unknown capacitance to be measured. Black lead should connect to the ground side of the unknown.
- Depress the "ON" button and select a "RANGE" push-button to give the highest on-scale reading.
- Read capacitance in pf on the meter scale corresponding to the depressed range button.

2.3.3 Measurement of Output Capacitance

In this mode the capacitance test instrument transmits a known capacitance signal to a capacitance detection instrument so that the instrument zero and span calibration or trip point setting may be determined or adjusted.

- a. Calibrate per paragraph 2.3.1.2 above.
- b. Connect the cable terminals to the capacitance input terminals of the instrument to be tested. (Be sure that the black lead is connected to the ground side of the input.)
- c. Push the "SEND" button in and then start depressing "OUTPUT CAPACITANCE" buttons in combination with the "OUTPUT VERNIER" until the desired response is achieved in the unit under test.
- d. Depress "ON" button.
- e. Depress "PUSH-TO-READ" button and select the "RANGE" button that gives the highest on-scale reading. This reading corresponds to the output capacitance in pf.

2.3.4 Monitoring Transmitter Output

The meter phone jack provided on the front of the instrument can be used to monitor output current of the transmitters while output capacitance values are being selected on the Capacitance Test Instrument. However, the phone plug must be removed before any internal measurements of the selected capacitance value can be made.

2.3.5 Applications

Using the capacitance Test Instrument, capacitance instrument may be precalibrated without varying the product level entirely from "full" to "empty". Also, products may be tested for their characteristics for utilizing capacitance level devices. Below are some applications for the Capacitance Test Instrument.

2.3.5.1 Remote Triax-Cable Devices

- a. Disconnect Triax Cable from the sensing probe.
- b. Calibrate capacitance test unit for input capacitance mode and then connect Tester cable to sensing probe, observing polarity of cable.
- c. Obtain Tester Capacitance reading per paragraph 2.3.2 and mark down reading.
- d. Physically measure level of product in vessel.
- e. Vary product level on probe several inches, if possible. The greater distance varied will result in more accurate readings from which to make later calculations.

NOTE

Product level variations may be made by actually removing or adding product to vessel or by unscrewing probe from vessel and raising and lowering probe in product. If this second method is utilized, insure that the ground connection between probe gland and vessel is maintained by using a jumper cable.

- f. By subtracting values obtained above and noting distance level was varied on sensing probe, the capacitance change per foot of product level may easily be determined.
- g. By using Pf/Ft value determined in (f) above and adding/subtracting from value at present actual product level on probe, the "Zero" and "Span" values required may be determined.

h. Disconnect Tester Cable from sensing probe and calibrate capacitance test unit per output capacitance.

- i. Connect to detector/TX.

NOTE

Always connect to probe end of Triax Cable.

- j. Using Capacitance Test Instrument in the output capacitance mode, adjust for the "Zero" value reading.

NOTE

If transmitter output is 4 to 20 milliamps, use the meter on the Test Instrument to monitor the output current of transmitter as described in paragraph 2.3.4.

- k. Repeat steps (i,j) except adjust for the Span Value. Capacitance Level Detector/Transmitter is now calibrated.

2.3.5.2 Direct Mounted Devices

- a. Remove Detector/Transmitter Circuit Board from conulet on probe.
- b. Calibrate Test Unit for input capacitance mode then take probe readings and determine values as in paragraph 2.3.5.1 above.
- c. Adjust Calibrator for "Zero" value as done in paragraph (h thru j) above.
- d. Apply power to Circuit Board.
- e. Adjust "Zero" on Circuit Board to required value.
- f. Repeat (c) thru (e) above for "Span" value, if analog transmitter. The same operation applies to Detectors for differential adjustment. Capacitance Level Detector/Transmitter is now calibrated.

2.3.5.3 Testing "Unknown" Products

- a. Obtain a Capacitance Sensing Probe. A 1-foot to 3-foot probe is ideal for this test.
- b. Place some of the unknown product into a metal container.
- c. Connect a jumper cable from probe gland to container.
- d. Calibrate Capacitance Test Unit for input capacitance mode then connect tester cable to sensing probe.
- e. Insert probe into product, noting distance probe is from vessel wall. Obtain capacitance reading.
- f. Pull probe partially out of product, maintaining same distance from vessel wall. Note distance removed and take second capacitance reading. From these values obtained, calculations for capacitance change per foot of product level can be easily made.

NOTE

This capacitance change per foot is true only for an installation with the probe the same distance from vessel wall as was used in the test.

- g. From this capacitance change per foot value and comparison with actual vessel size, the proper sensing probe and installation can be determined.

SECTION III MAINTENANCE

3.1 GENERAL

Normal maintenance should consist of a periodic check of the battery. To replace the battery, the front panel must be removed from the box by unscrewing the four screws at the corners.

3.2 CALIBRATION PROCEDURE

3.2.1 (Part 1)

- a. Remove front panel assembly by removing the four mounting screws at the corners, and carefully lifting out the assembly.
- b. Check mechanical null of meter and if necessary readjust.

NOTE:

Meter must be removed from panel assembly for access to null adjust on front of meter.

- c. Using an accurate capacitance standard, select each full scale reading value and adjust the corresponding pot visible from the back side of the assembly. Start out on the 3000 pf range.
- d. Select the standard for a half scale reading and verify that the meter reading is accurate within $\pm 2\%$ of full scale. If so repeat steps (c and d) for all ranges. If half scale reading of any of the five ranges is not accurate, then proceed to Part 2 of the Calibration Procedure.

3.2.2 (Part 2)

Zero Adjustment (0% Point)

The zero adjustment can be obtained by the use of the "FINE ZERO" adjustment located in the upper left corner on the front side of the Printed Circuit Board. The "FINE ZERO" adjustment is a multi-turn potentiometer (approximately 20 turns). Clockwise rotation of the adjustment will increase the output signal. The adjustment is capable of varying between 0 and 60 pf of terminal capacitance.

Span Adjustment

The span adjustment can be obtained by use of the "FINE SPAN" adjustment located in the upper left corner on the front side of the Printed Circuit Board. The "FINE SPAN" adjustment is a multi-turn potentiometer (approximately 20 turns). Clockwise rotation of the adjustment will increase the output signal. The adjustment is capable of varying the span capacitance a range between 10 and 3000 pf.

- a. Select the 30 pf range, remove BNC Test Lead and depress "ON" switch.
- b. Position the "ZERO" adjust on the front panel all the way clockwise and adjust the "FINE ZERO" until the output current indicates approximately 5 ma. Slowly turn the "FINE ZERO" adjustment counterclockwise until the output indicates exactly 1 pf. DO NOT OVERADJUST, otherwise non-linearity or interaction between Span and Zero will occur. Now adjust front panel "ZERO" for 0% on meter dial, and then select the 3000 pf range.

- c. Using a capacitance standard of 3000 pf, adjust the "FINE SPAN" until the output meter indicates 100% (20 ma). Clockwise rotation of the "FINE SPAN" adjustment will increase the output current. The instrument is now calibrated and ready for operation.

- d. Now go back to Part 1 and verify all positions except 3000 pf as it is already calibrated.

3.2.3 Null Adjustment Calibration

This adjustment is factory set and further adjustment should not be required. However, should calibration of cable compensation adjustment be required, perform the following procedure.

- a. Depress "ON" switch, select 30 pf range and make sure meter reads 0%.
- b. Remove cable and adjust the "NULL" adjustment until the output indicates 0% or one pointer width below. "NULL" adjustment is located in the upper left corner of the front side of the Printed Circuit Board.

3.2.4 Cable Compensation Calibration

This adjustment is factory set and further adjustment should not be required. However, should calibration of cable compensation adjustment be required, perform the following procedure.

- a. Depress "ON" switch, select 30 pf range and zero meter.
- b. Make sure that "OUTPUT VERNIER" is at minimum setting and all "OUTPUT CAPACITANCE" select pushbuttons are out before proceeding.
- c. Now connect the 6-inch BNC Test Lead to the end of this test lead hook up of a capacitance measuring device (this could be another Capacitance Test Unit if available).
- d. Depress "SEND" switch and measure the capacitance value. This is the minimum input capacitance that can be simulated by the test unit and should be between 30 and 40 pf.
- e. Depress "PUSH-TO-READ" switch. Remove cover from "CABLE COMP" and adjust the "CABLE COMP" pot until the meter capacitance reading equals the measure value in step (d).
- f. Calibration is now complete. Replace the cover over the "CABLE COMP" pot.

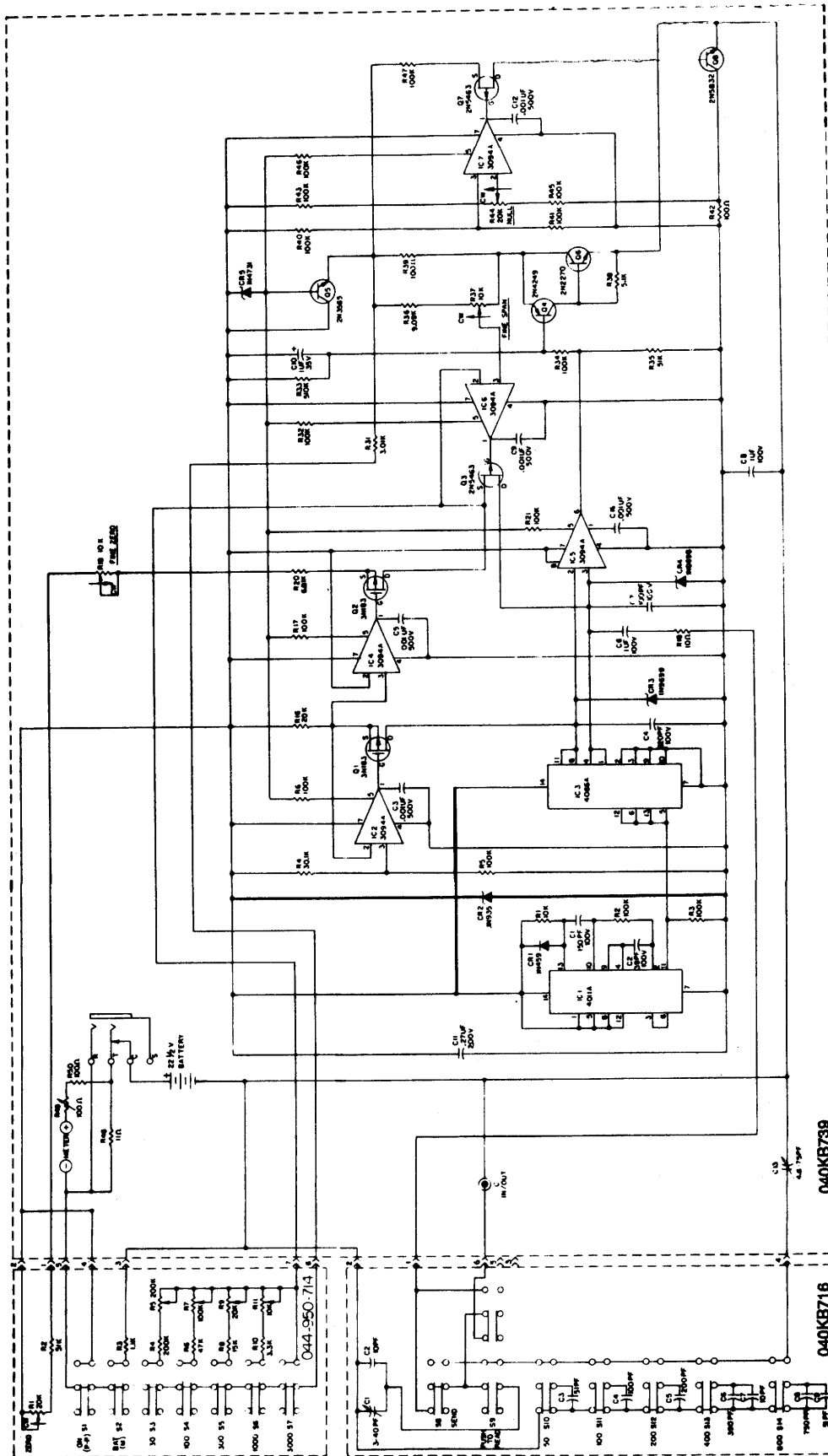


Figure 3-1. Schematic Diagram.

SECTION IV

PARTS LIST

Name	Robertshaw Part No.
Phone Plug to Phone Plug Cable	032KB330-01
Phone Jack to Alligator Clip Cable	032KB330-02
BNC Plug to Alligator Clip Cable (6" Long)	032KB330-04
Battery	016KB006
Meter	210KB091
Meter Scale	040KB730-04
Case	040KB474



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