

**INTERMEDIATE AND DEPOT
MAINTENANCE MANUAL
PARTICLE COUNTER TEST SET
TSI 3705**

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LIST OF EFFECTIVE PAGES

Insert latest changes; destroy superseded pages.

Total number of pages in this manual 17, consisting of the cover page plus the following:

Section	Page No
SECTION 1	1
SECTION 2	Error! Bookmark not defined.
SECTION 3	Error! Bookmark not defined.
SECTION 4	5

CONTENTS

Section.....	Page No
1.0 INTRODUCTION AND DESCRIPTION	1
1.1 INTRODUCTION	1
1.2 PURPOSE	1
1.3 INTRODUCTION	4
2.0 SAFETY INSTRUCTIONS AND EMERGENCY PROCEDURES.....	Error! Bookmark not defined.
2.1 INTRODUCTION	Error! Bookmark not defined.
2.2 SAFETY PRECAUTIONS	Error! Bookmark not defined.
3.0 REQUIRED EQUIPMENT	Error! Bookmark not defined.
3.1 GENERAL.....	Error! Bookmark not defined.
4.0 CALIBRATION PROCEDURE	5
4.1 0.500 μ m & 0.700 μ m SAMPLE SOLUTION PREPARATION	5
4.2 5.00 μ m SAMPLE SOLUTION PREPARATION	Error! Bookmark not defined.
4.3 PRELIMINARY OPERATION.....	Error! Bookmark not defined.
4.4 SAMPLE FLOW RATE ACCURACY VERIFICATION ...	Error! Bookmark not defined.
4.5 ANALOG OUTPUT VERIFICATION.....	Error! Bookmark not defined.
4.6 PULSE WIDTH OUTPUT VERIFICATION	11
4.7 DIGITAL COMPARISON VERIFICATION	Error! Bookmark not defined.
4.8 ZERO COUNT VERIFICATION	Error! Bookmark not defined.

TABLES

Table 1 Specifications	4
Table 2 Required Equipment.....	Error! Bookmark not defined.

FIGURES

Figure 1 3705 Ribbon Cable Connection.....	6
Figure 2 3705 Main Menu Selection.....	7
Figure 3 3705 Preliminary Analog Output Test Selection	8
Figure 4 3705 Error Message Analog Output Test Selection	8
Figure 5 COM1 Settings.....	9
Figure 6 3705 0.5 μ m Analog Output Test Selection	10
Figure 7 Adjustment Location.....	Error! Bookmark not defined.
Figure 8 3705 5.0 μ m Analog Output Test Selection	Error! Bookmark not defined.
Figure 9 3705 6.4 Pulse Width Verification.....	11
Figure 10 3705 16.0 Pulse Width Verification.....	12
Figure 11 3705 Digital Comparison Test	13
Figure 12 3705 Zero Count Test	Error! Bookmark not defined.

SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 INTRODUCTION

- 1.1.1 Review and become familiar with the entire calibration procedure before beginning the calibration process.

1.2 PURPOSE

- 1.2.1 This procedure describes the calibration process for the TSI 3705 Laser Particle Counter Test Set.

SECTION 2

SAFETY INSTRUCTIONS AND EMERGENCY PROCEDURES

2.1 GENERAL

- 2.1.1 Unless otherwise designated, and prior to beginning the Calibration Process, ensure that all test voltage and/or current outputs are set to zero (0) or turned off where applicable.
- 2.1.2 Ensure that all equipment switches are set to the proper setting position before making connections or applying power.

2.2 SAFETY PRECAUTIONS

- 2.2.1 Voltages hazardous to personnel may be encountered during the sequence of this test procedure.
- 2.2.2 This procedure does not require Personal Protection Equipment.
- 2.2.3 This procedure does not require Lock Out Tag Out Procedures.

SECTION 3

REQUIRED EQUIPMENT

3.1 GENERAL
3.2

Table 1 Required Equipment

Manufacturer / Model Nomenclature	Function/Range	Accuracy/Uncertainty/Range
TSI 3705 LPC Calibrator UUT	DC & Pulse Amplitude	2.0% $\pm$ 1Mv of reading
2 - Fluke 8020B Digital Multimeters	DC Voltage 0 to 20 V	$\pm$ 0.25 % of Reading
HP 8116A Pulse Generator	Pulse Width	$\pm$ 5.0% $\pm$ 2.0nS
Clarostat 240C Variable Resistor	Resistance	$\pm$ 5.0% @ 1 Ω Range $\pm$ 2.0% on all other Ranges
PC Running TSI Test System Software		
TSI 3705 Sensor Ribbon Cable Adapter		
TSI 3705 Test & Ref Input, Output Decoupling Capacitor		

NOTE

Test Equipment having the same or better specifications and characteristics may be substituted for the equipment shown in Error! Reference source not found..

SPECIFICATIONS

Table 2 Specifications

Function	Range	Accuracy
Threshold Voltage	0.5um @ J2-3	0-10V $\pm$ 100mV
Threshold Voltage	5.0um @ J2-6	0-10V $\pm$ 100mV
Pulse Height Analyzer	0.5um @ J2-7	0-10V $\pm$ 200mV
Pulse Height Analyzer	5.0um @ J2-8	0-10V $\pm$ 200mV
Pulse Width Accuracy	1 - 17us	$\pm$ 500nS
Count Test	Ref & Test Inputs	$\pm$ 1 Count
Power Supply Test	Ref & Test Outputs	>22V @ 175mA

Accuracy Specifications Assigned by USA Calibration Engineering

SECTION 4

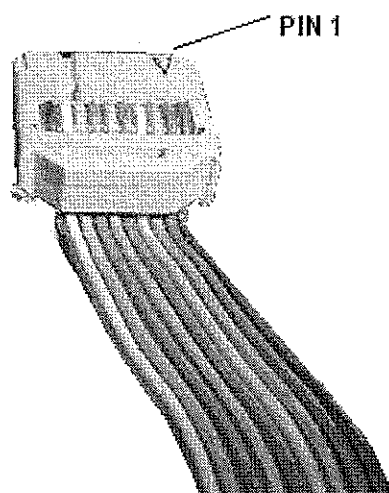
CALIBRATION PROCEDURE

- 4.1 Connect the TSI 3705 Sensor Ribbon Cable Adapter to the TSI 3705 Sensor Ribbon Cable. Pin 1 of cable connector is marked with a V. All upper pins are odd numbered. Connect a BNC Cable to the Linear Output of the Locally Built Model 200 Kennedy Space Center Test Set and a BNC to EZ Hook adapter on the other end. Connect the Black EZ Hook to the loop on J2- 9 (ground reference) of the Cable Adapter. Connect the Red EZ Hook to the loop across Pin J2-3 & J2-7 of the Cable Adapter. Connect one end of a BNC Cable to the 0.5um Analog output and the other end of the BNC Cable to a BNC to Banana adapter to the Fluke 8020 DVM.

NOTE

The ribbon cable and the UUT's receptacle are **NOT KEYED**. Ensure the Arrow on the Ribbon Cable is properly aligned before continuing.

Figure 1 3705 Ribbon Cable Connection



- 4.5.1 Start the PC. Locate CAL7850 Icon and Double click to start the 7850 Test System Calibration Software. Power up the 3705 (UUT), and the KSC Model 200.

Figure 2 3705 Main Menu Selection

PMS PMS Automatic LPC Calibration System V1.3 Main Menu
Commands and Parameter Selection Options

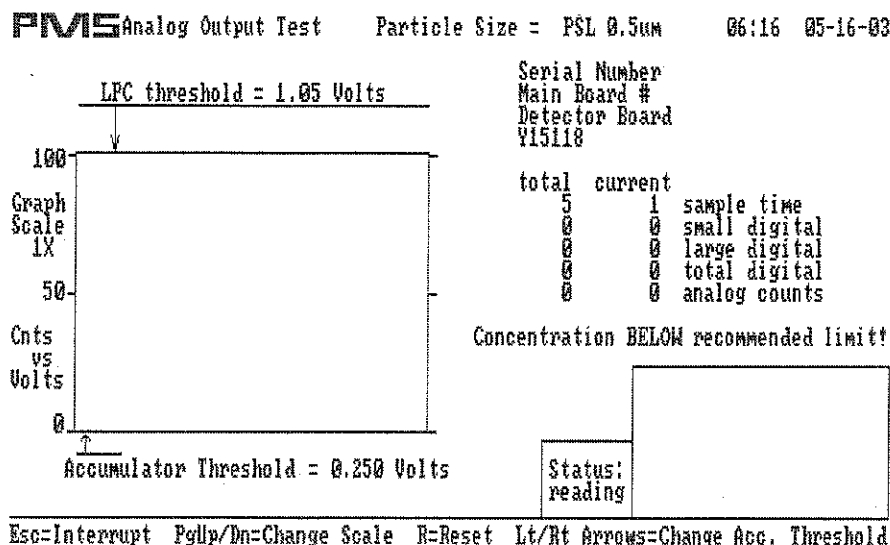
- (1) Run Analog Output Test
(2) Run Digital Comparison Test (S) Stop The Program
(3) Run Pulse Width Check Test

parameter to set	current parameters	
(4) Toggle Particle Size (Analog Test)	PSL 0.5um	Small particle label
(5) Change Particle Size Label	PSL 5.0um	Large particle label
(6) Test LPC Serial #	(6091)	
(7) Test LPC Main Board #	(3087)	
(8) Test LPC Detector Board #	(8949)	
(9) Test LPC Misc. Information	(Y15118)	
(0) Reference LPC Misc. Information (for Digital Comparison Test ONLY)	(Z17793)	

Press Key For The Desired Option

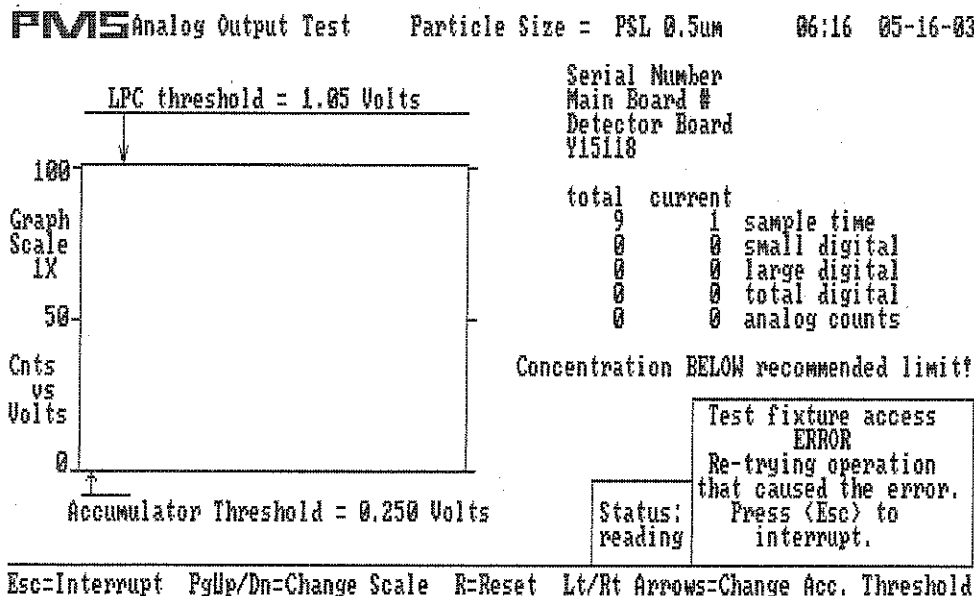
- 4.5.2 **Select** "Run Analog Output Test" from 7850 Calibration Software's Main Menu
- 4.5.3 **Observe** the two boxes in the lower right-hand side of the PC's Display. The large box should remain blank and the small box should alternately highlight the word "Reading" or "Displaying" as shown in Figure 3.

Figure 3 3705 Preliminary Analog Output Test Selection



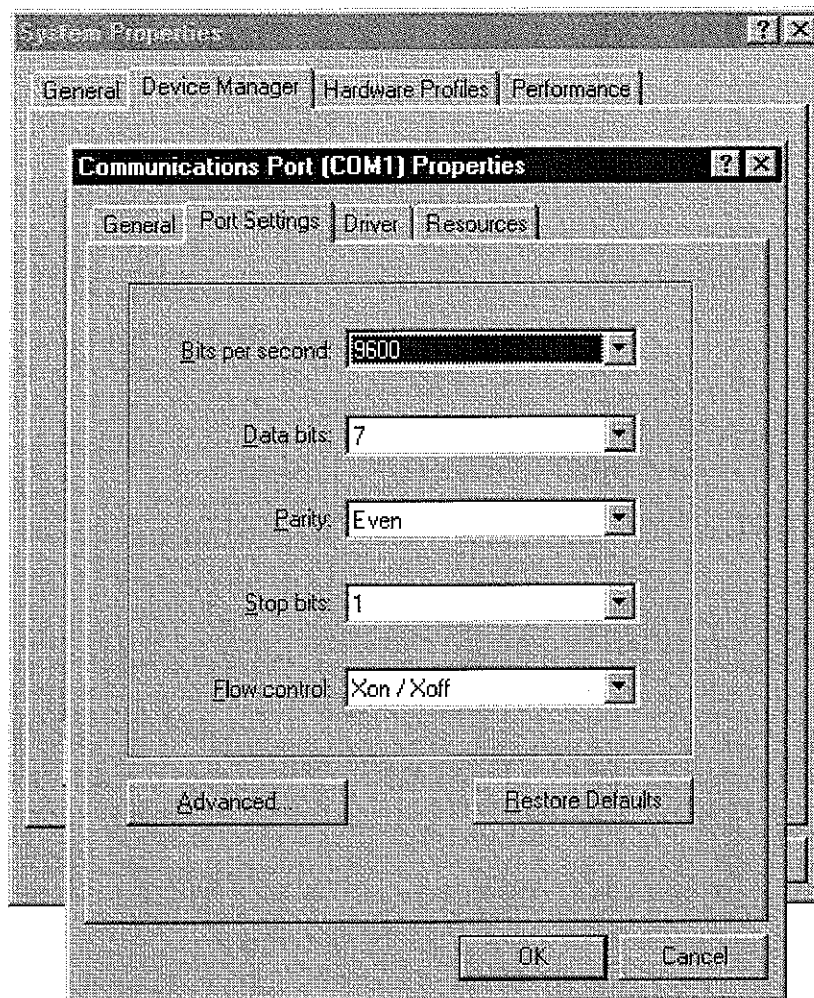
- 4.5.4 If the large box displays "Test Fixture Access ERROR" as shown in Figure 4, then proceed with step 4.5.5, Else skip to step Error! Reference source not found..

Figure 4 3705 Error Message Analog Output Test Selection



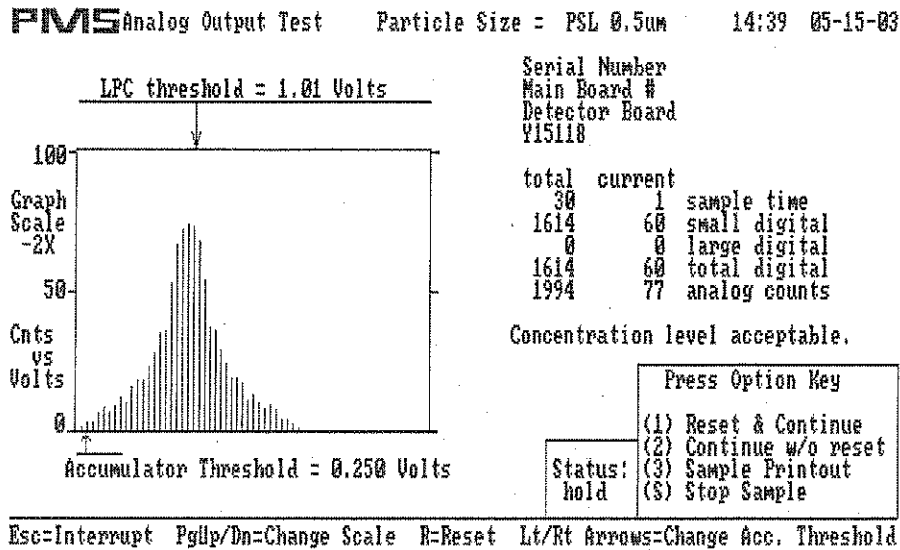
- 4.5.5 Ensure the 3705's Rear Panel RS232 port is connected to the PC's COM1 Port.
- 4.5.6 Ensure the PC's COM1 port is configured as shown in Figure 5.

Figure 5 COM1 Settings



- 4.5.7 **Ensure** steps **Error! Reference source not found.** through **Error! Reference source not found.** were performed properly.
- 4.5.8 **Cycle** the 3705's POWER ON/OFF control.
- 4.5.9 **If** the problem persists, **Then** consult the 3705's Service Manual for further troubleshooting guidance, **Else** continue with step **Error! Reference source not found.**

Figure 6 3705 0.5µm Analog Output Test Selection



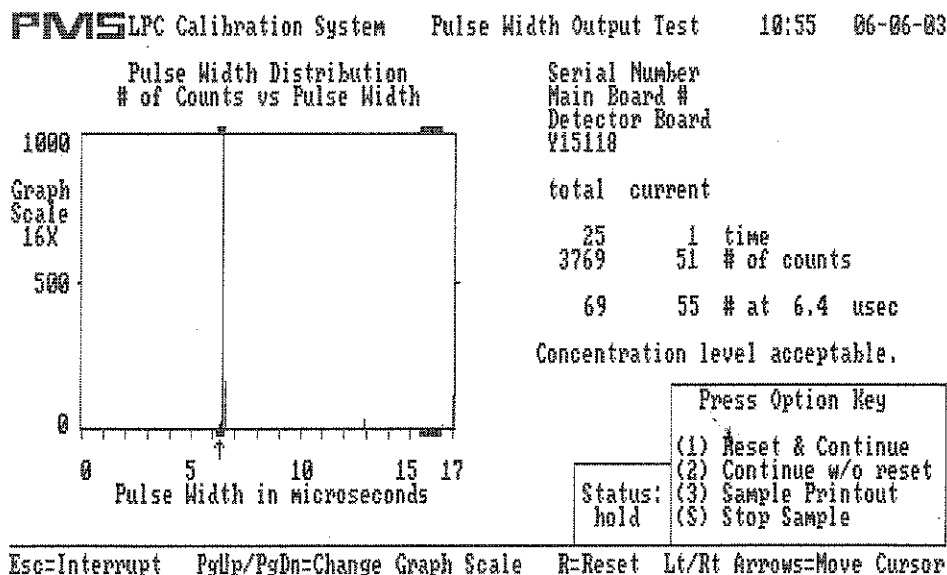
- 4.5.10 **Adjust** The Kennedy Space Center Model 200 Test Set Pulse Amplitude to 8.00V and set the X1 / X10 Switch to X10 PC. The Display should start accumulating on 1 or 2 channels. Press the DC button on the test set and The LPC Threshold should display 8.00V $\pm$ 0.1V and the Arrow should line up with the accumulated channel $\pm$ 1 channel. The DVM should read 8.00V Verifying the 0.5µm Analog Output.
- 4.5.11 **Repeat** Step 4.5.10 at Pulse Amplitudes of 6.00, 4.00, 2.00, & 1.00V
- 4.5.12 **Move** the Red EZ Hook to the loop across Pin J2-6 & J2-8 of the Cable Adapter.
- 4.5.13 **Select** the ESCAPE key to "Interrupt" the measurement process.
- 4.5.14 **Select** the "Stop Sample" from the Press Option Key Menu to return the Main Menu.
- 4.5.15 **Set** the Calibration Software's Current Parameter to PSL 5.0µm using the "Toggle Particle Size (Analog Test)" Main Menu selection.
- 4.5.16 **Select** the "Run Analog Output Test" from 7850 Calibration Software's Main Menu.
- 4.5.17 **Adjust** The Kennedy Space Center Model 200 Test Set Pulse Amplitude to 8.00V and set the X1 / X10 Switch to X10 PC. Move the end of a BNC Cable connected to the 0.5µm Analog output to the 5.0µm Analog Output. The Display should start accumulating on 1 or 2 channels. Press the DC button on the test set and The LPC Threshold should display 8.00V $\pm$ 0.1V and the Arrow should line up with the accumulated channel $\pm$ 1 channel. The DVM should read 8.00V Verifying the 5.0µm Analog Output.

- 4.5.18 **Repeat** 4.5.17 at Pulse Amplitudes of 6.00, 4.00, 2.00, & 1.00V
- 4.5.19 **Select** the "Stop Sample" from the Press Option Key Menu to return the Main Menu.

4.6 PULSE WIDTH OUTPUT VERIFICATION

- 4.6.1 **Connect** one end of a BNC Cable to the HP8116 Pulse Generator Output. Connect the other end of the BNC Cable to a 50Ω Termination, connected to the Decoupling Capacitor adaptor, which is connected to the TSI 3705 Test Input / Output.
- 4.6.2 **Power up** the HP8116 and set it for a 1Khz, 5Volt Pulse with a 6.4us Pulse Width.
- 4.6.3 **Select** the "Run Pulse Width Check" from 7850 Calibration Software's Main Menu.
- 4.6.4 The display should look similar to Figure 7.

Figure 7 3705 6.4 Pulse Width Verification



- 4.6.5 **Use** the Page Up and Page Down keys to set the GRAPH SCALE as required.
- 4.6.6 **Use** the Left and Right Arrow keys to align the arrow at the bottom of the display with the Acquired pulse as shown in Figure 7.

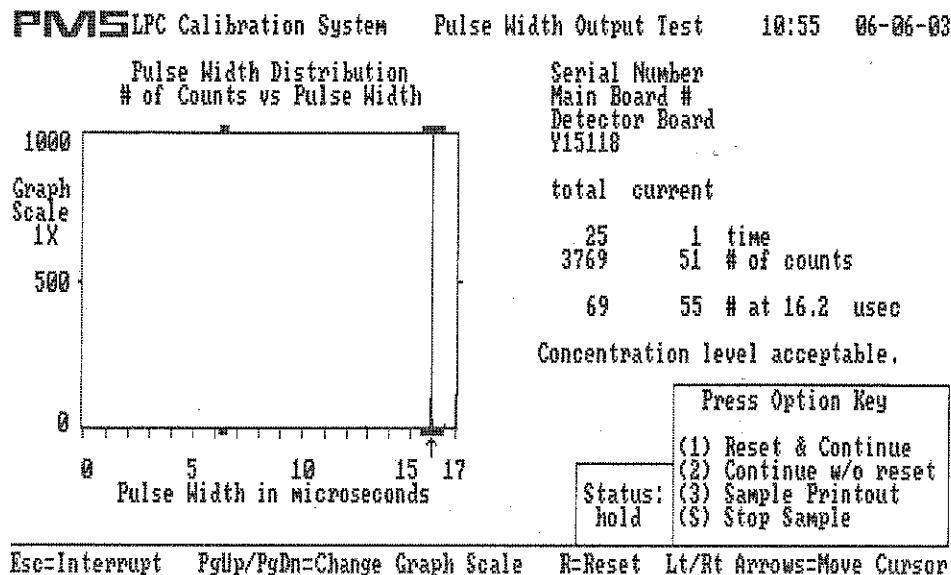
NOTE

When the arrow at the bottom of the display is properly aligned with the 6.4uS pulse, the "total / current # at x.x usec" on the display will begin to increment.

- 4.6.7 **Select** the ESCAPE key to "Interrupt" the measurement process.

- 4.6.8 The displayed value must be $6.4\mu\text{S} \pm 500\text{nS}$.
- 4.6.9 **Select** the "Reset & Continue" from the Press Option Key Menu to "Continue" the measurement process.
- 4.6.10 **Set** The HP8116 16.0us Pulse Width.

Figure 8 3705 16.0 Pulse Width Verification



- 4.6.11 **Use** the Left and Right Arrow keys to align the arrow at the bottom of the display with the Acquired pulse as shown in Figure 8.

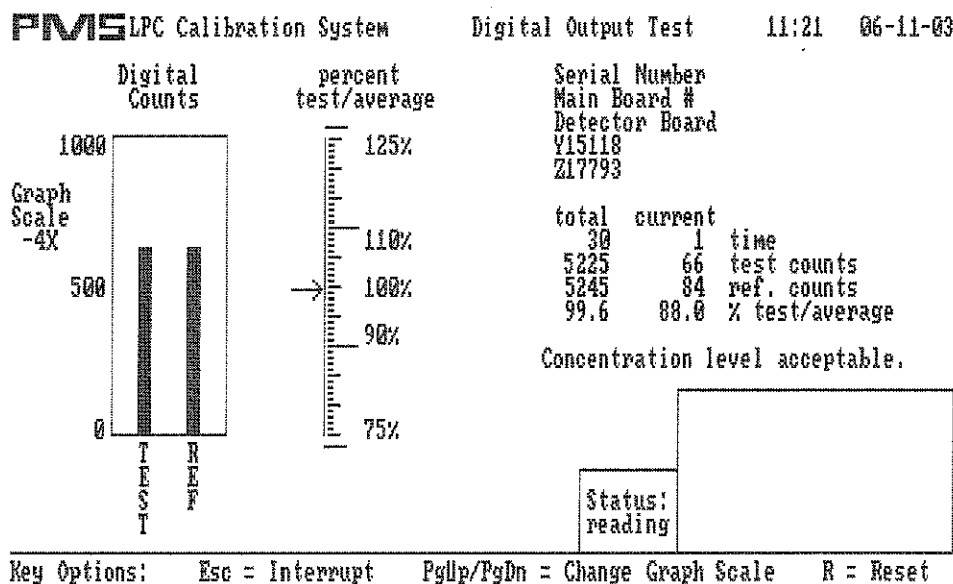
NOTE

When the arrow at the bottom of the display is properly aligned with the 16uS pulse, the "total / current # at x.x usec" on the display will begin to increment.

- 4.6.12 **Select** the ESCAPE key to "Interrupt" the measurement process.
- 4.6.13 The displayed value must be $16.0\mu\text{S} \pm 500\text{nS}$. **Select** the "Stop Sample" from the Press Option Key Menu to return the Main Menu.
- 4.7 **COUNT TEST**
- 4.8 **LEAVE** the Equipment connected, as is step 4.6.1.
- 4.9 **Set** the HP8116 for a 1Khz, 5Volt Pulse with a 6.4us Pulse Width. Set the function to E. Burst and set the Burst Count to 10.
- 4.10 **Select** the "Run Digital Comparison Test" from 7850 Calibration Software's Main Menu.

4.7.1 The display should look similar to Figure 9.

Figure 9 3705 Digital Comparison Test



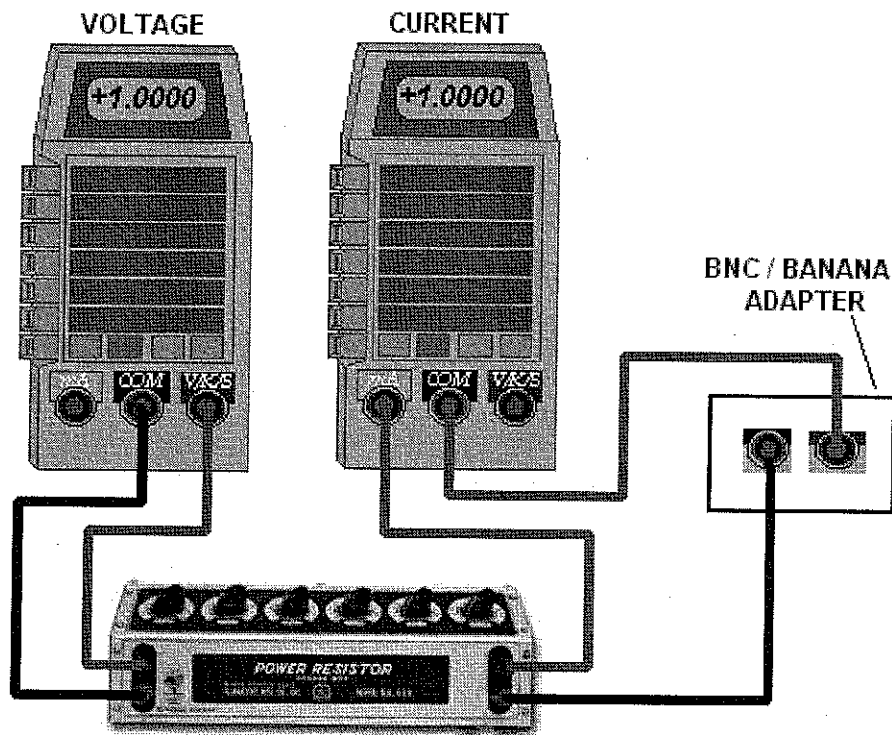
- 4.7.2 **Note** that each time the HP 8116 Manual Trigger button is pressed the Current Test Counts Increments by 10. *TEST COUNTS*
- 4.7.3 **Set** the HP 8116 burst to 100, then 300 and verify that each time the HP 8116 Manual Trigger button is pressed the Current Counts Increments to 100, and 300 respectively.
- 4.7.4 **Move** cable which is connected to the TSI 3705 Test Input / Output to the TSI 3705 Ref Input / Output.
- 4.7.5 **Repeat** steps 4.72, and 4.73

4.11 POWER SUPPLY VERIFICATION

4.12 **Switch** the 3705 (UUT) Power to off

4.13 **Connect** the Equipment as show in figure 10. Connect the BNC to Banana Adapter to the TSI 3705 Test Input / Output.

Figure 10 3705 Power Supply Output Test



- 4.7.1 **Set** the "Current" DVM to DC, Current, 200mA Range, and the "Voltage" DVM to DC Volts, 200V Range.
- 4.7.2 **Set** all The Clarostat switches to 9.
- 4.8.1 **Switch** the 3705 (UUT) Power to on.
- 4.8.2 **Starting** with the 100KΩ Range turn the Settings down one at a time while Monitoring the Current until the Display reads 175Ma. Check that the Voltage displayed is > 22V. Switch the DVM to AC and Check for Excessive Ripple.
- 4.8.3 **Switch** the 3705 (UUT) Power to off.
- 4.8.4 Connect the BNC to Banana Adapter to the TSI 3705 REF Input / Output.
- 4.8.5 **Set** all The Clarostat switches to 9.
- 4.8.6 **Switch** the 3705 (UUT) Power to on.

- 4.8.7 **Starting** with the 100K Ω Range turn the Settings down one at a time while Monitoring the Current until the Display reads 175Ma. Check that the Voltage displayed is > 22V. Switch the DVM to AC and Check for Excessive Ripple.
- 4.8.8 Disconnect and secure all equipment.