

Aeroflex 3920



APX™ Mobile and Portable Automated Test and Alignment

Operational Requirements

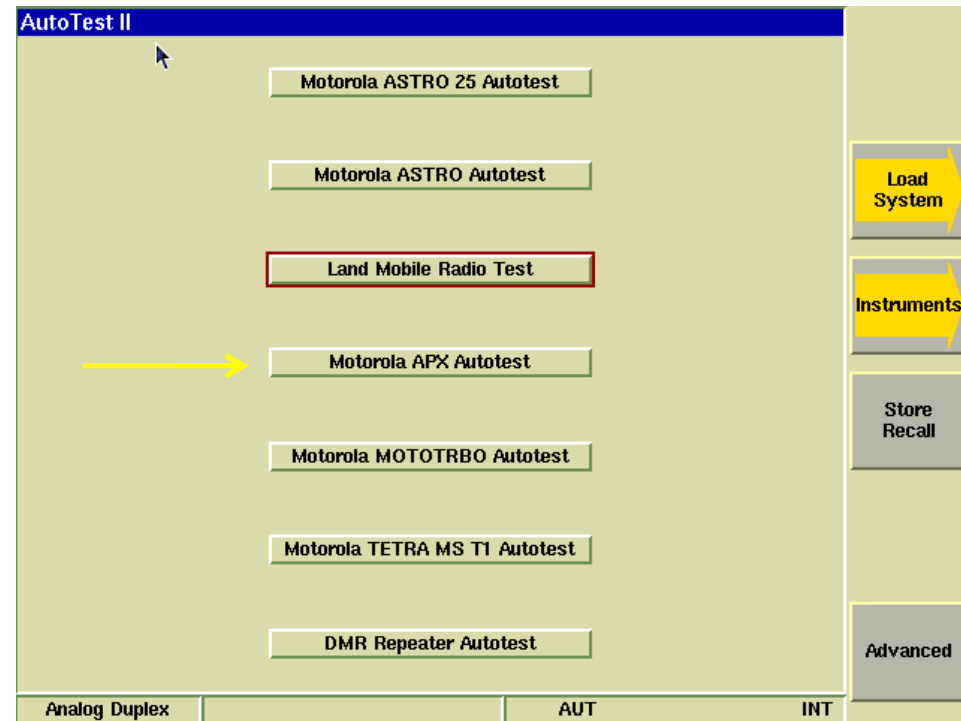
- ▼ **Aeroflex 3920**
- ▼ **Option 061 – Tracking Generator**
- ▼ **Option 200 – P25 Conventional Operation**
- ▼ **Option 218 – Auto-Test II for P25**
- ▼ **Option 220 – (Optional – Allows testing of Phase II TX and RX)**
- ▼ **Option 604 – Motorola APX Series Auto-Test and Alignment**
- ▼ **AC24011 – 10 AMP Current Shunt 0.01 Ohm (for Mobile Power Alignment)**
- ▼ **Power Supply**
- ▼ **Battery Eliminator (for portables)**
- ▼ **Test Cable (Low Loss Phase Stable recommended for best accuracy)**
- ▼ **Reference Cable (Short 6’)**
 - 3 dB Pad (Optional but recommended for best accuracy)
- ▼ **Connector Adapters**
- ▼ **For best accuracy, an external high accuracy rubidium time base should be used for frequency test and alignment.**

Auto-Test II Menu

The Auto-Test II Menu can be accessed by:

- Right click with mouse and select Auto-Test II.
- Select Auto-Test II from the system menu. Access to this menu can be accomplished by selecting the CONFIG key twice to access the system menu.

Select Motorola APX Auto-Test from the Auto-Test II menu.



APX Primary Test Screen

Function Keys

F1 – Test

Start testing the radio. No alignments will be made. Only a test report of pass/fail results. Radio model will be automatically identified and appropriate specification table will be used for testing.

F2 – Align and Test

All selected items that are capable of being aligned will be aligned. Performance tests will also be performed to validate the alignment. (Aeroflex Recommended)

F3 – Test and Align

All selected tests will be tested. Any failed item will be aligned and then re-tested after alignment.

F4 – Edit Specs / Cable Loss

Only required when initially setting up the system for a specific model of radio. Must be reviewed prior to testing a new model of radio or when changing test cables.

F5 – View Results

Allows access to the test results display. Test results may be viewed, recalled or backed up to a USB memory device.

F6 – More

Access to Radio Connect diagrams and special features.

AutoTest II

APX7000 Alignment 2.8.0
3900 Software Version 3.2.0

Select All Tests

Reset Test Menu

	<input checked="" type="checkbox"/> VHF	<input checked="" type="checkbox"/> UHF R1	<input checked="" type="checkbox"/> UHF R2	<input checked="" type="checkbox"/> 800/900
<input checked="" type="checkbox"/> PA Bias (Mobile Align)	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Reference Oscillator	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Rx Front End (Align)	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Broadband Power	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Deviation Balance (Align)	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> P25 Tx Tests	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> P25 Rx BER Test	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Phase II Tx Tests	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Phase II Rx BER Test	No Test	No Test	No Test	No Test

☒ View results while testing ☐ Enable long format logging

☒ Test Low Power ☒ Connect messages beep when waiting

☒ Beep at end of test ☐ Reset USB @ end of test

P25 AUT RF INT

Test

Align and Test

Test and Align

Edit Specs Cable Loss

View Results

More

Return

APX Primary Test Screen

Test Selections

Allows any combination of tests or alignments to be performed on any single or multiple bands.

Everything can be selected and the application will not attempt to perform invalid operations on the radio.

Select All Tests

This will enable all tests.

Reset Test Menu

This will disable all tests.

VHF/UHF/800 band selections

Only selected bands will be tested.

All bands may be selected and the application will only tests bands that exist in the radio being tested.

Note: The reference oscillator will be tested on the highest band and frequency that is selected for test.

View Results while testing

The application will stay on this screen and show only current status Testing/Passed/Failed if not selected. When selected and the test or alignment function has been executed, the screen will change and all testing can be viewed as it occurs.

Test Low Power

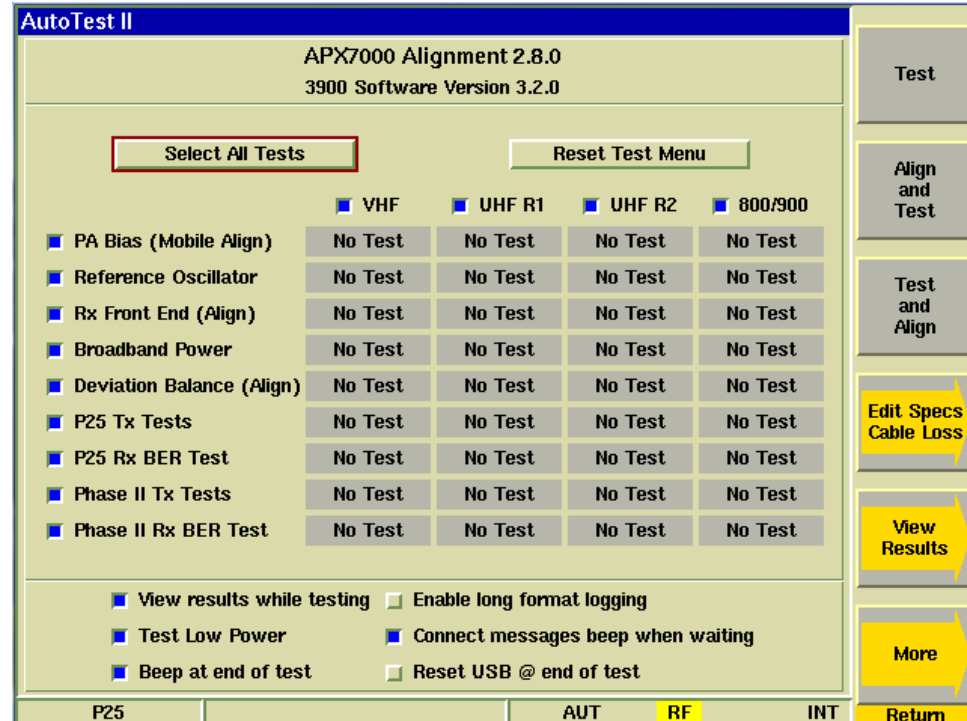
Some users do not use low power on the radios and they can reduce test time by not testing low power levels if this option is enabled.

Beep at end of test

The 3920 will produce an audible beep at the completion of the test to draw attention to the operator that the test or alignment is done.

Enable long format logging

Diagnostic mode that shows all adjustments to soft pot values.



The screenshot shows the 'AutoTest II' software interface for 'APX7000 Alignment 2.8.0' and '3900 Software Version 3.2.0'. It features a table of test selections for VHF, UHF R1, UHF R2, and 800/900 bands. Tests include PA Bias, Reference Oscillator, Rx Front End, Broadband Power, Deviation Balance, P25 Tx Tests, P25 Rx BER Test, Phase II Tx Tests, and Phase II Rx BER Test. All are currently set to 'No Test'. A 'Select All Tests' button is highlighted. On the right, a vertical menu contains 'Test', 'Align and Test', 'Test and Align', 'Edit Specs Cable Loss', 'View Results', 'More', and 'Return'. At the bottom, there are checkboxes for 'View results while testing', 'Test Low Power', 'Beep at end of test', 'Enable long format logging', 'Connect messages beep when waiting', and 'Reset USB @ end of test'. The bottom status bar shows 'P25', 'AUT', 'RF' (highlighted), and 'INT'.

	VHF	UHF R1	UHF R2	800/900
PA Bias (Mobile Align)	No Test	No Test	No Test	No Test
Reference Oscillator	No Test	No Test	No Test	No Test
Rx Front End (Align)	No Test	No Test	No Test	No Test
Broadband Power	No Test	No Test	No Test	No Test
Deviation Balance (Align)	No Test	No Test	No Test	No Test
P25 Tx Tests	No Test	No Test	No Test	No Test
P25 Rx BER Test	No Test	No Test	No Test	No Test
Phase II Tx Tests	No Test	No Test	No Test	No Test
Phase II Rx BER Test	No Test	No Test	No Test	No Test

☒ View results while testing ☐ Enable long format logging
☒ Test Low Power ☒ Connect messages beep when waiting
☒ Beep at end of test ☐ Reset USB @ end of test

P25 AUT RF INT

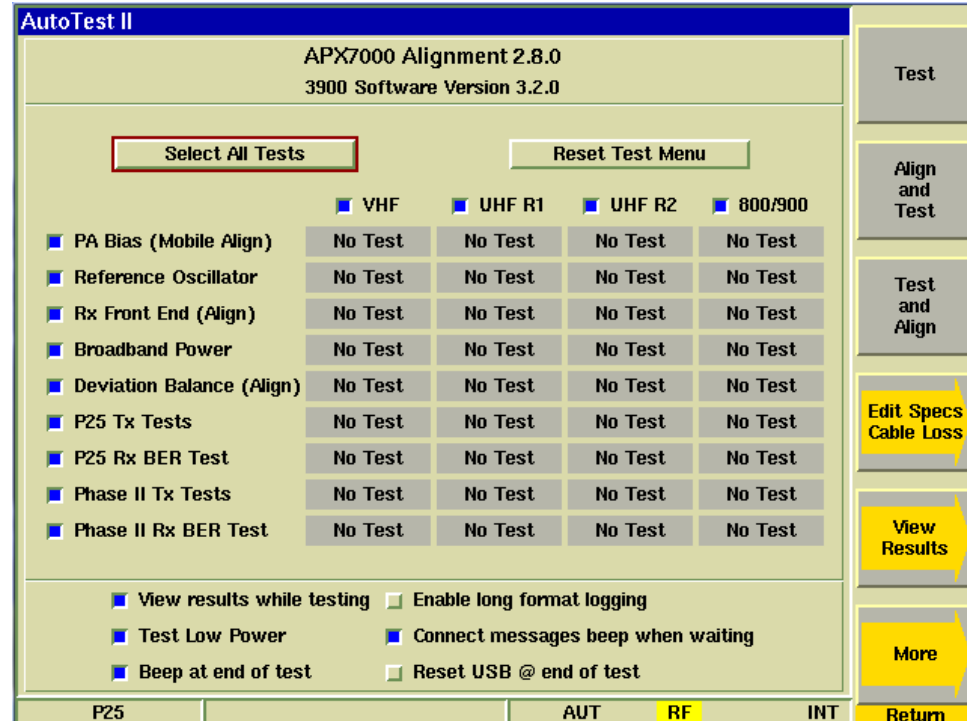
Test Selections

Connect messages beep when waiting

When testing dual band mobiles, you will be prompted to move the test cable when moving from one band connector to the other. This option will produce an audible beep for the operator to change the cable connection. Note: The highest frequency band that is selected is always tested first.

Reset USB @ end of test

Some mobiles require this setting to be enabled. It does not cause any issue to have it selected for other radios.



The screenshot shows the 'AutoTest II' software interface for 'APX7000 Alignment 2.8.0' and '3900 Software Version 3.2.0'. The interface includes a 'Select All Tests' button, a 'Reset Test Menu' button, and a table of test options for VHF, UHF R1, UHF R2, and 800/900 MHz bands. The 'Test' button is highlighted in yellow. The 'Return' button is also highlighted in yellow.

	VHF	UHF R1	UHF R2	800/900
<input checked="" type="checkbox"/> PA Bias (Mobile Align)	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Reference Oscillator	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Rx Front End (Align)	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Broadband Power	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Deviation Balance (Align)	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> P25 Tx Tests	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> P25 Rx BER Test	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Phase II Tx Tests	No Test	No Test	No Test	No Test
<input checked="" type="checkbox"/> Phase II Rx BER Test	No Test	No Test	No Test	No Test

☒ View results while testing ☐ Enable long format logging
☒ Test Low Power ☒ Connect messages beep when waiting
☒ Beep at end of test ☐ Reset USB @ end of test

P25 AUT RF INT Return

Function Keys

F1 – Save As

Save all modifications to specifications to a user specified file.

F2 – Save

Save all modifications to specifications to the currently loaded specification configuration file.

F3 – Recall

Recall a different specification file.

F4 – Recall Current Radio

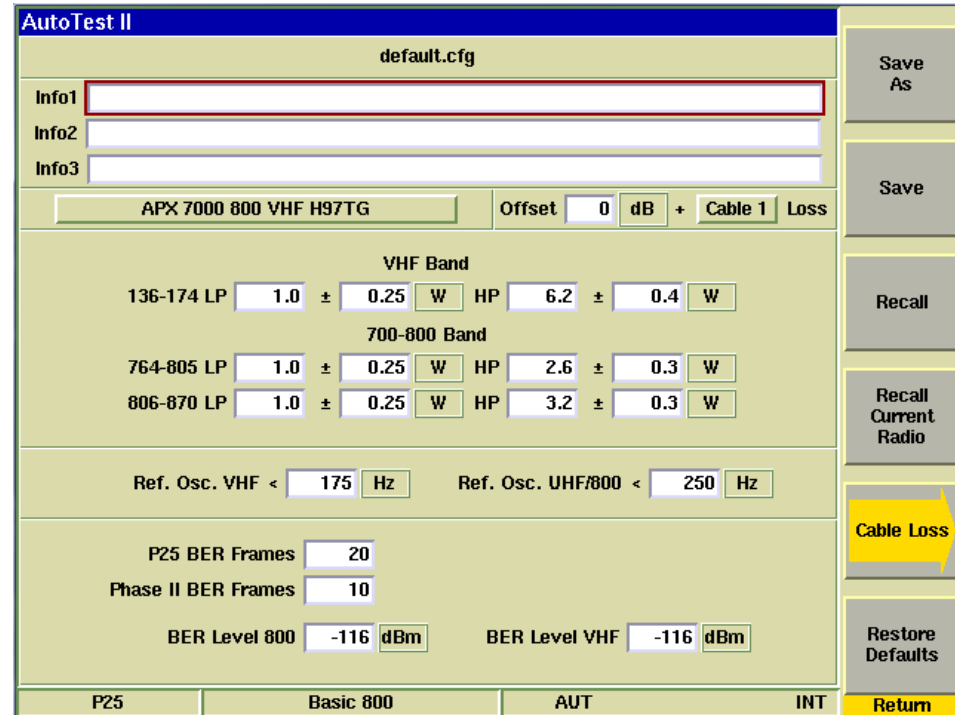
Interrogate the connected radio for model number and show the specifications for that radio.

F5 – Cable Loss

Access to the cable loss measurement application. **Note: This is one of the first things that should be done prior to testing a radio.**

F6 – Restore Defaults

Resets all of the specifications to all of the radios from memory. This the factory default specifications. Note, these values are not permanently stored unless you answer yes to update the currently loaded specification file when you exit this screen by pressing the Return key.



AutoTest II

default.cfg

Info1

Info2

Info3

APX 7000 800 VHF H97TG Offset 0 dB + Cable 1 Loss

VHF Band

136-174 LP 1.0 ± 0.25 W HP 6.2 ± 0.4 W

700-800 Band

764-805 LP 1.0 ± 0.25 W HP 2.6 ± 0.3 W

806-870 LP 1.0 ± 0.25 W HP 3.2 ± 0.3 W

Ref. Osc. VHF < 175 Hz Ref. Osc. UHF/800 < 250 Hz

P25 BER Frames 20

Phase II BER Frames 10

BER Level 800 -116 dBm BER Level VHF -116 dBm

P25 Basic 800 AUT INT

Save As

Save

Recall

Recall Current Radio

Cable Loss

Restore Defaults

Return

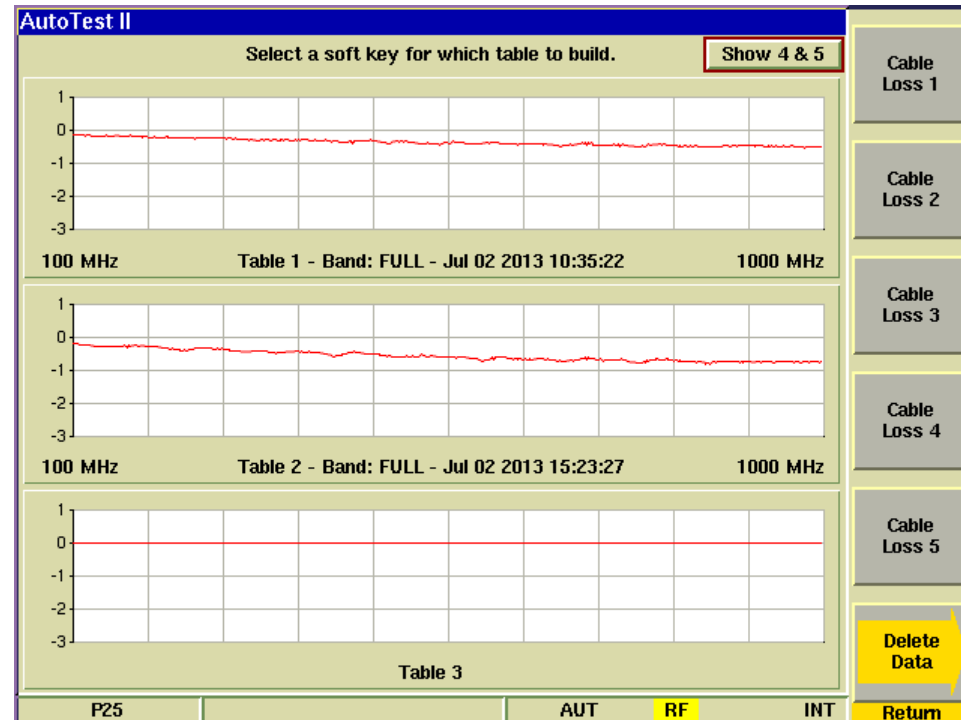
Function Keys

Cable 1 - 5

Choose up to 5 different cable plots. These are initially flat with no calibration. After making a selection, prompts will be provided for cable connection and the cable insertion loss will be measured.

Delete Data

Allows deletion of a cable sweep.



Test Cable Calibration

Reference Cable

The 3920 will use its spectrum analyzer and tracking generator to sweep this reference cable and will establish this sweep as a zero reference.

This cable is used **ONLY** for calibration purposes and will not be used for testing the radio.

Getting more accurate results

To obtain better results from this process, use a 3 dB pad at the end of the reference cable that is connected to the TR port of the 3920. This will improve the VSWR of the cable for when it is connected to the Radio Testing Cable.

Reference Sweep

Gen port -> Reference Cable -> 3 dB Pad -> TR port

Radio Testing Cable Sweep

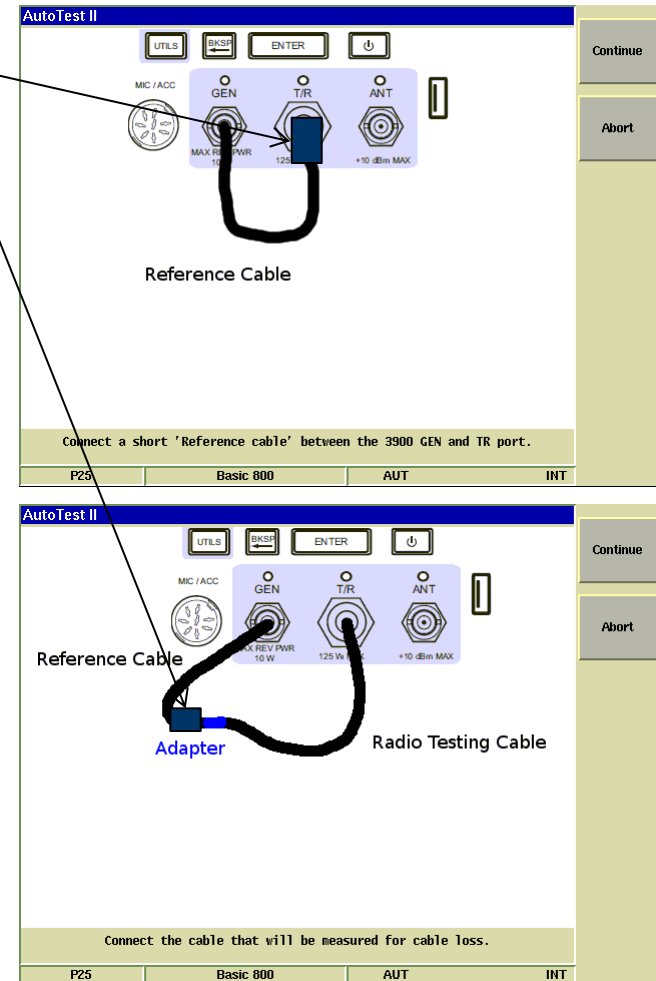
After the Reference cable sweep has been completed, you will be prompted to connect the Radio Testing Cable in line with the Reference cable. The 3920 will again use its spectrum analyzer and tracking generator to sweep the combined cables and will plot the difference between the two sweeps as the insertion loss of the cable that was added.

Radio Testing Sweep

Gen port -> Reference Cable -> 3 dB Pad -> Adapter -> Radio Testing Cable -> TR port

NOTE: The on screen instructions make no mention of the use of an external pad for this calibration.

3 dB Pad



Results of cable calibration

Trace 1

This calibration was done as directed without the use of the 3 dB external attenuator.

Trace 2

This calibration was done with the same Radio Test Cable but a 3 dB attenuator was used when calibrating the Reference cable.

Trace 3

This calibration is done with the external 3 dB attenuator and a high quality, low loss, phase stable cable.

The Difference

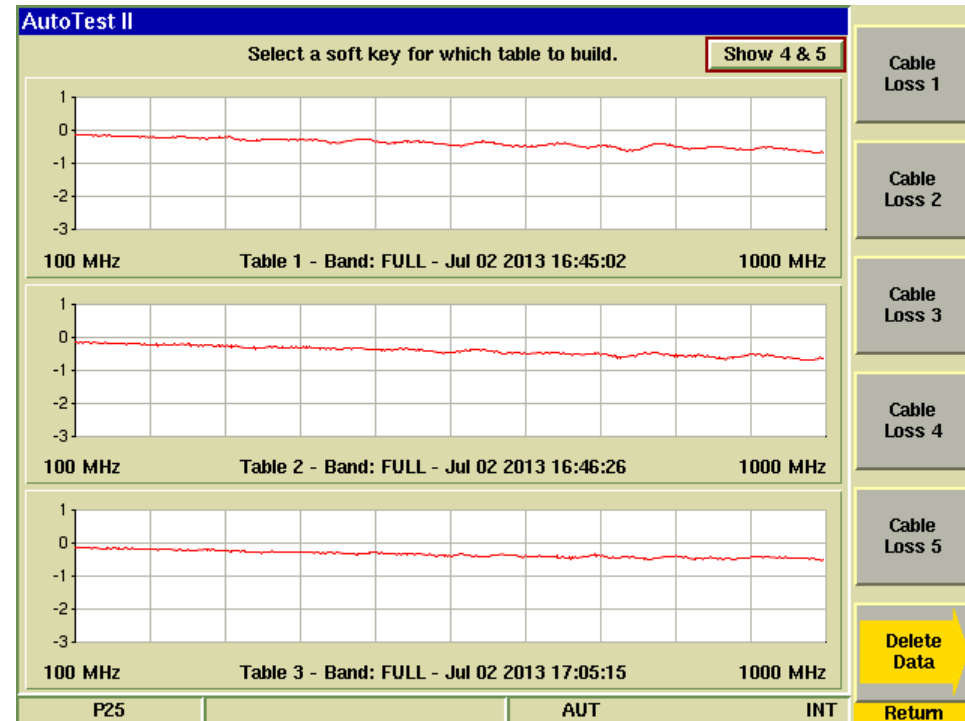
Results will vary depending on the quality and length of the test cable. This test was done with a 3ft RG-58 test cable.

Notice that Trace 1 is not as flat as trace two. These waves are caused by a VSWR mismatch at the point where the cables are connected together. Use of the 3 dB pad at this junction improves the VSWR and minimizes some of these standing waves.

The Impact

When calibrating the transmitter power, even small amounts of error in the insertion loss measurement can cause the radio to fail the test. An insertion loss of 0.4 dB that is not accounted for can cause up to a 10% error in power measurement.

With Dual Band radios, it is important to note that the insertion loss at low frequencies is less than the insertion loss at higher frequencies so one fixed entry for cable loss will not correct the power meter in both bands correctly.



APX Edit Specs Screen

Specification values

Model Selection

This is used to access the specifications for supported models. Note that the specifications used when testing a radio are automatically determined after the radio model has been identified at the beginning of a test sequence.

Offset/Cable Loss

These values are used to correct the power meter for TX Tests and RF Generator for RX Tests. If you are using an external 6 dB high power attenuator, you can enter that value as an offset. You can additionally use a cable sweep plot to compensate for a test cable. This feature is primarily needed for testing or aligning Transmitter power levels.

Power Levels

For Portables and Mobiles, the default values should not be changed. The radios are tested and aligned at TEST MODE power levels and not the programmed power levels.

Specifications are NOT to be used as acceptance tests for new radios as this application is meant to replace the Tuner application. These tolerances are Alignment tolerances which are tighter.

Reference Oscillator

These values are used for testing. If Alignment is selected, the radio will be aligned as close to 0 Hz error as possible. Note that an External Reference is recommended.

RX BER Tests

The number of frames is the number of frames that are averaged in the radio prior to reporting a BER reading. The BER Level is the RF Injection level from the 3920. The radio should have 5% or less BER at this test level.

AutoTest II

APX 7000 800 VHF H97TG de1

Info1 APX 6500 UHF2 M25SS
Info2 APX 6500 VHF M25KS
Info3 APX 7000 800 VHF H97TG
APX 7000 UHF1 800 H97TG
APX 7000 UHF1 H99QD
APX 7000 UHF1 VHF H97TG

Offset 0 dB + Cable 1 Loss

VHF Band
136-174 LP 1.0 ± 0.25 W HP 6.2 ± 0.4 W

700-800 Band
764-805 LP 1.0 ± 0.25 W HP 2.6 ± 0.3 W
806-870 LP 1.0 ± 0.25 W HP 3.2 ± 0.3 W

Ref. Osc. VHF < 175 Hz Ref. Osc. UHF/800 < 250 Hz

P25 BER Frames 20
Phase II BER Frames 10
BER Level 800 -116 dBm BER Level VHF -116 dBm

P25 Basic 800 AUT INT

Radio View

General
Log Dispatch Calls Enable
Time Format 12 hr
Date Format mm/dd/yy Domestic
Ultra Narrow Intermediate Freq Filter 5.76 kHz

Transmit Power Levels

Frequency Range	Frequency Range S	Frequency Range E	Tx Power Level Min	Tx Power Level Low	Tx Power Level High	Tx Power Level Max
VHF	136.000000	174.000000	1.00	2.50	5.00	6.20
7/800 MHz	764.000000	805.999995	1.00	1.20	2.65	2.65
7/800 MHz	806.000000	870.000000	1.00	1.20	3.20	3.20
UHF1	380.000000	470.000000	1.00	2.20	4.00	5.30
UHF2	450.000000	520.000000	1.00	1.20	5.30	5.30
800 MHz	896.000000	941.000000	1.00	1.20	2.75	2.75

Administration

Create a Password

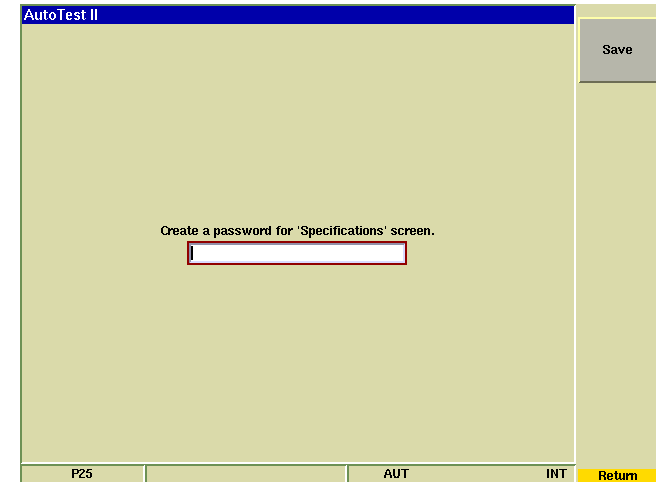
Allows entry of a password for access to the Edit Specs screen. If users are not allowed to make changes to the radio test specifications, a password may be entered here and must be entered to gain access to the Edit Specs screen.

Reset Password

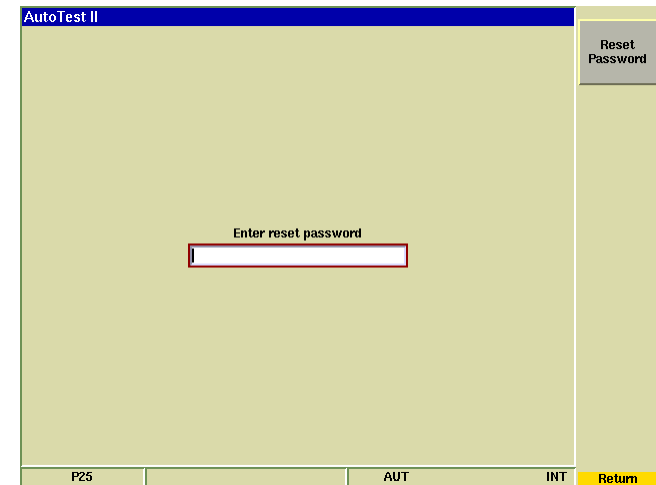
After a password has been entered, the only way to remove it is to enter the following Reset Password value:

85856767

After this value has been entered, press the Reset Password button and the password protection will be removed and a new password may be entered if desired.



The screenshot shows the 'AutoTest II' application window. The main area is olive green with a blue title bar. In the center, the text 'Create a password for 'Specifications' screen.' is displayed above a single-line text input field. On the right side, there is a vertical toolbar with a 'Save' button. At the bottom, there is a status bar with buttons labeled 'P25', 'AUT', 'INT', and a yellow 'Return' button.



The screenshot shows the 'AutoTest II' application window. The main area is olive green with a blue title bar. In the center, the text 'Enter reset password' is displayed above a single-line text input field. On the right side, there is a vertical toolbar with a 'Reset Password' button. At the bottom, there is a status bar with buttons labeled 'P25', 'AUT', 'INT', and a yellow 'Return' button.

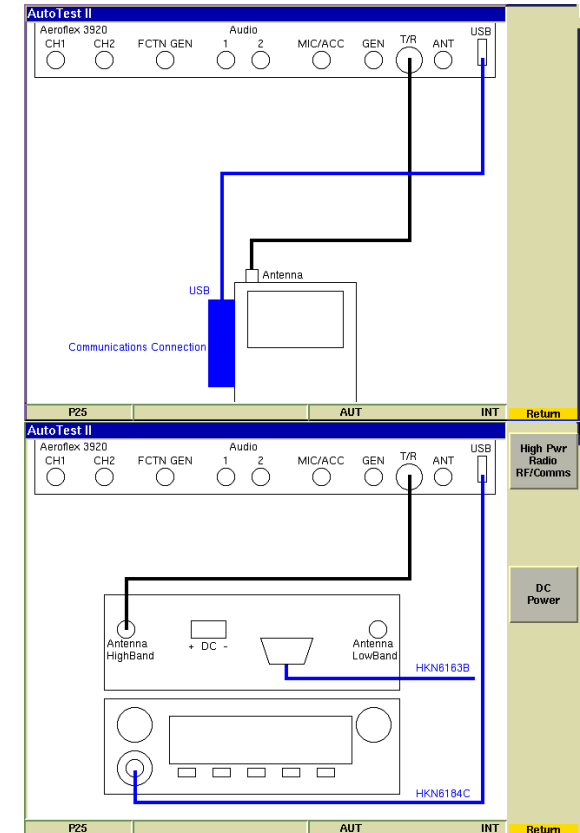
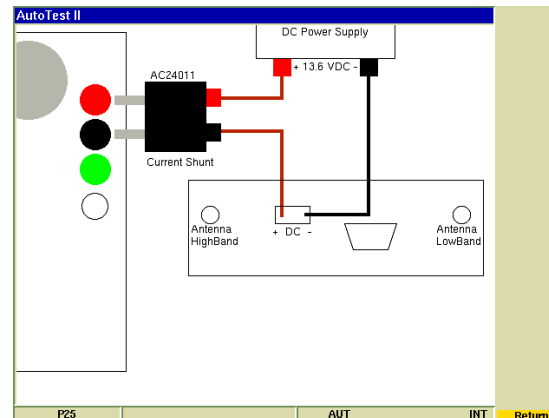
Radio Connections to the 3920

Interconnect for Portable Radio

1. The Portable radio requires a USB connection from the radio to one of the Aeroflex 3920 USB ports.
2. Requires an RF Cable connection from the 3920 TR port to the radio ANT port.
3. Recommended connection to a battery eliminator and power supply.

Interconnect for Mobile Radio

1. The Mobile radio requires a USB connection from the radio to one of the Aeroflex 3920 USB ports. The radio may be connected through the connector on the radios rear section or to the radios control head.
2. The AC24011 current shunt must be used and connected as the diagram indicates only for Power alignment. The current shunt is not required for power testing.
3. The power supply should be capable of supplying the required amount of current and the current limiting should not be set too low. Proper gauge wires should also be used.
4. For connection to the current shunt, the positive wire must be cut and connected to the current shunt as indicated in the drawing. The current shunt is connected to the 3920's V/ohm and COM connectors on the DMM.



Radio Test screen

Test Results Screen

Shows Time Date stamp along with the 3920's serial number and version information for both the system and the application.

Shows radio model, serial number along with radio software versions and configurations.

Shows the Flash Code

Load File

Allows a different test results file to be loaded and displayed.

Print Results

Prints the test results to a printer that is connected to the 3920 or a network printer if configured for this in the systems printer configuration screen.

Clear

Clears the currently displayed results from the screen.

Copy Results to USB

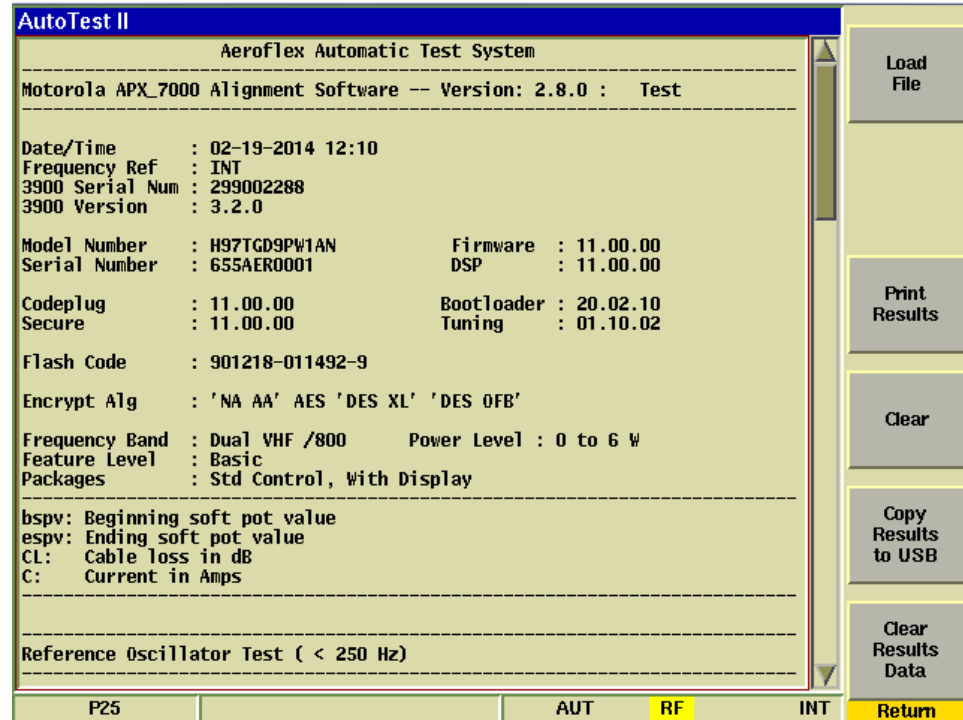
Copies ALL test result files from the 3920's hard drive to a connected USB memory stick.

Clear Results Data

Deletes all test results files from the 3920's hard drive.

Test Results

As tests are performed, the results along with pass/fail information is provided.



AutoTest II

Aeroflex Automatic Test System

Motorola APX_7000 Alignment Software -- Version: 2.8.0 : Test

Date/Time : 02-19-2014 12:10
Frequency Ref : INT
3900 Serial Num : 299002288
3900 Version : 3.2.0

Model Number : H97TGD9PW1AN Firmware : 11.00.00
Serial Number : 655AER0001 DSP : 11.00.00

Codeplug : 11.00.00 Bootloader : 20.02.10
Secure : 11.00.00 Tuning : 01.10.02

Flash Code : 901218-011492-9

Encrypt Alg : 'NA AA' AES 'DES XL' 'DES OFB'

Frequency Band : Dual VHF /800 Power Level : 0 to 6 W
Feature Level : Basic
Packages : Std Control, With Display

bspv: Beginning soft pot value
espv: Ending soft pot value
CL: Cable loss in dB
C: Current in Amps

Reference Oscillator Test (< 250 Hz)

P25 AUT RF INT Return

Buttons on the right: Load File, Print Results, Clear, Copy Results to USB, Clear Results Data

Thank You

Aeroflex 3920



APX Mobile and Portable Automated Test and Alignment