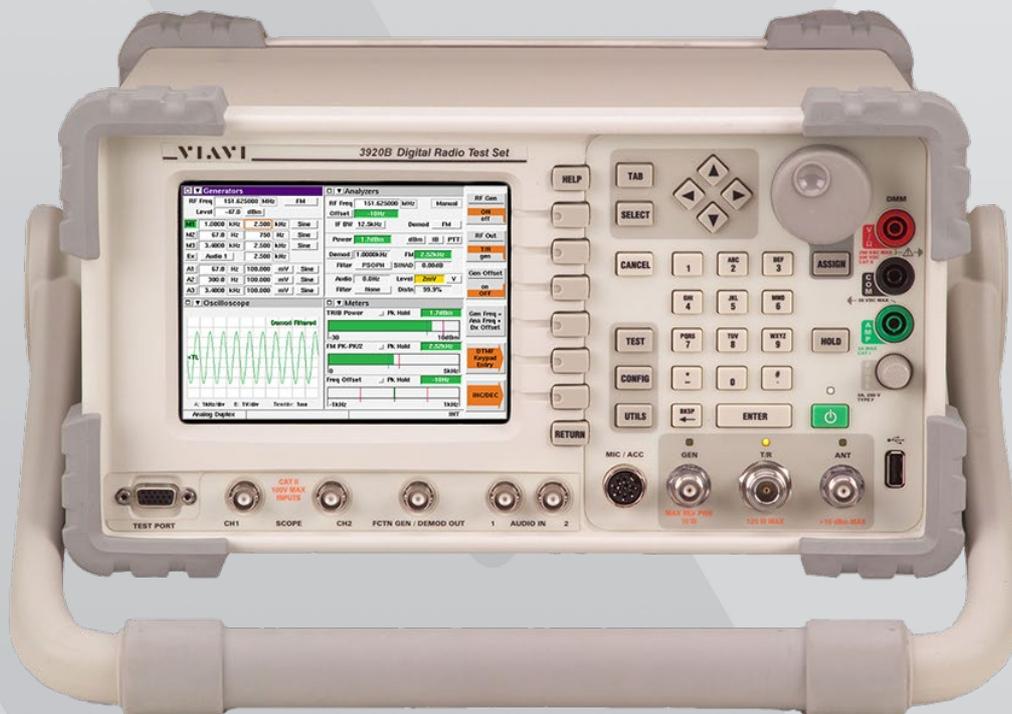


Motorola MOTOTRBO™ Auto-Test and Alignment

3920B Radio Test Platform



Motorola MOTOTRBO™ Auto-Test and Alignment 3920B Radio Test Platform

This guide describes how to setup and use the Motorola MOTOTRBO Auto-Test application on the 3920B.

Supported Models by Region

| North America | Asia | Europe | Latin America |
|--|---|------------------------------------|--|
| CM200d / CM300d | XiR M3188 / 3688 | DM1400 / 1600 | DEM 300 / 400 |
| CP200d | XiR P3688 | DP1400 | DEP 450 |
| SL300 | SL1M | SL1600 | SL470 / 500 |
| SL7550 / 7580 / 7590 | SL1K | SL4000 / 4010 | SL8050 / 8550 |
| XPR 2500 | XiR M6660 | DM2600 | DEM 500 |
| XPR 3300 / 3500 | XiR P6600 / 6620 | DP2400 / 2600 | DEP 550 / 570 |
| XPR 4350 / 4380 / 4550 / 4580 | XiR M8220 / 8228 / 8260 / 8268 | DM3400 / 3401 / 3600 / 3601 | DGM 4100 / 4100+ / 6100 / 6100+ |
| XPR 5350 / 5380 / 5550 / 5580 | XiR M8620 / 8628 / 8660 / 8668 / CM7668 | DM4400 / 4401 / 4600 / 4601 | DGM 5000 / 5500 / 8000 |
| XPR 6100 / 6300 / 6350 / 6380 / 6500 / 6550 / 6580 | XiR P8100 / 8200 / 8208 / 8260 / 8268 | DP3200 / 3400 / 3401 / 3600 / 3601 | DGP 4050 / 4150 / 4150+ / 6150 / 6150+ |
| XPR 7350 / 7380 / 7550 / 7580 | XiR P8600 / 8608 / 8620 / 8628 / 8660 / 8668 / CP7668 / GP328D / GP338D | DP4401 / 4600 / 4601 / 4800 / 4801 | DGM 4100 / 4100+ / 6100 / 6100+ |

Equipment Requirements

3920B with options

- Option 061 – Tracking Generator
- Option 400 – DMR Conventional Operation
- Option 401 – Auto-Test II for DMR
- Option 610 – Motorola MOTOTRBO Series Auto-Test and Alignment

Test Hardware

- VIAVI 112277 – 10 Amp Current Shunt 0.01 Ohm (for Mobile PA BIAS Alignment)
- Radio Programming Cable (See Table 1)
- Audio Test Box – RLN4460 (See Table 1 for model compatibility)
- Variable Power Supply (30 Amp rating for High Power mobiles)
- Battery Eliminator and Interface Box (for portables)
 - Battery Eliminator (See Table 1)
 - Motorola RLN 4510 if available)
- Test Cable (Low Loss Phase Stable recommended for best accuracy) BNC (M) – BNC (M)
- Reference Cable (Short 6”) BNC (M) – BNC (M)
- 10 dB attenuator BNC (M) – BNC (F) (Optional but recommended for best accuracy)
- Connector Adapters
 - BNC (F) – BNC (F)
 - N (M) – BNC (F)
 - Antenna Test Adapter (See Table 1)
 - Antenna Adapter Holder (See Table 1)
- For best accuracy, the 3920B should be connected and configured to use an external 10 MHz Standard.
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**Motorola MOTOTRBO™ Auto-Test and Alignment
3920B Radio Test Platform**

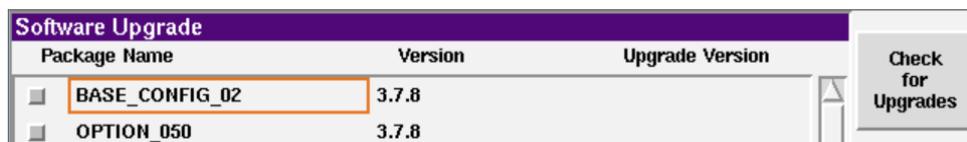
| Motorola Part Numbers | | | | | | |
|--|----------|-------------------|--------------------|----------------|-----------------|------------------------|
| Subscriber | Type | Programming Cable | Battery Eliminator | Audio Test Box | Antenna Adapter | Antenna Adapter Holder |
| CP200d | portable | PMKN4128 | 0180305K08EPP | RLN4460 | 5886564Z01 | n/a |
| XPR 3300 / 3500 | portable | PMKN4115 | PMNN4428 | RLN4460 | PMLN6154 | PMLN6201 |
| XPR 6100 / 6300 / 6350 / 6380 / 6500 / 6550 / 6580 | portable | PMKN4012 | PMNN4076 | RLN4460 | 5880348B33 | n/a |
| XPR 7500 IS | portable | PMKN4012B+ | PMLN6430 | RLN4460 | 5880384G68 | n/a |
| XPR 7350 / 7380 / 7550 / 7580 | portable | PMKN4012B+ | PMNN4428 | RLN4460 | PMLN6154 | PMLN6155 |
| SL 300 | portable | CB000262A01 | HW000405A01 | RLN4460 | 28012039001 | HW000406A01 |
| SL 7550 / 7580 / 7590 | portable | 25-124330-01R | HW000405A01 | n/a | 28012039001 | 7012042001 |
| CM200d / CM300d | mobile | PMKN4147 | n/a | RLN4460 | n/a | n/a |
| XPR 2500 | mobile | PMKN4147 | n/a | RLN4460 | n/a | n/a |
| XPR 4350 / 4380 / 4550 / 4580 | mobile | PMKN4010 | n/a | RLN4460 | n/a | n/a |
| XPR 5350 / 5380 / 5550 / 5580 | mobile | HKN6184 | n/a | RLN4460 | n/a | n/a |

Table 1

Note: The above table includes radio models for the North American region. For a list of the comparable model names for all regions please reference the above supported models list or Motorola’s documentation.

Before you Begin

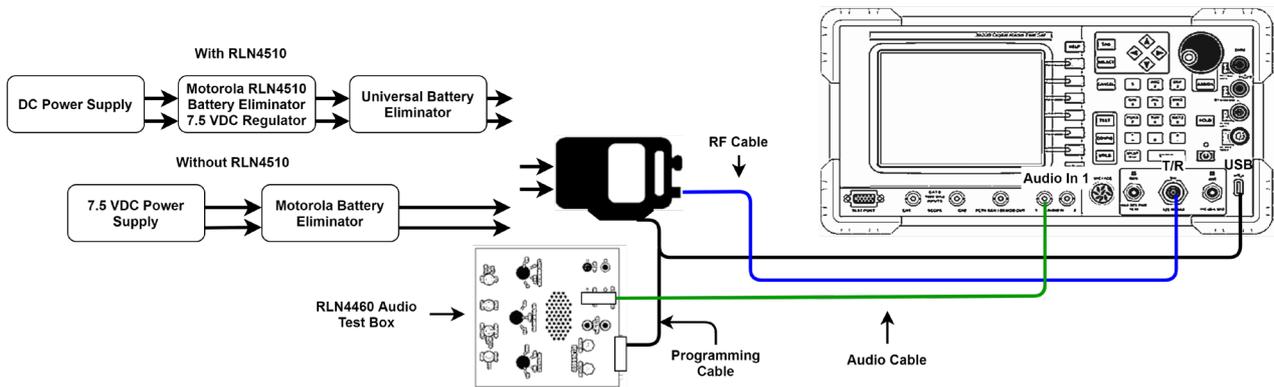
- Before testing begins, be sure to check the system software version of your 3920. Press the UTILS key (twice) to access the Utilities menu. Choose Software Settings>Software Upgrade to see the installed software versions.
- The system software version is indicated next the “BASE_CONFIG”. The Motorola MOTOTRBO application version is indicated to the right of OPTION_604.



- Check for software updates on the VIAVI 3920 Series Software webpage at www.viavisolutions.com/en-us/software-download/3920-series-software. The current system software version is displayed next to 3920 Series Software Update.
- If the system software version is older than the version listed on this site, download the software, release notes, and installation instructions and update your system software. The system software download includes the latest Auto-Test Software Update.
- If the system software version is current, check your Auto-Test application version, as the test scripts are updated more frequently than system software. The Auto-Test Release Notes will list current versions in order of most recently updated.
- The Auto-Test Software Update includes all currently released test scripts.

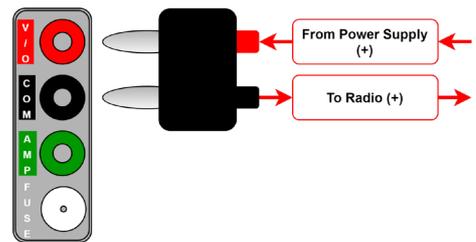
MOTOTRBO Portable Interconnect

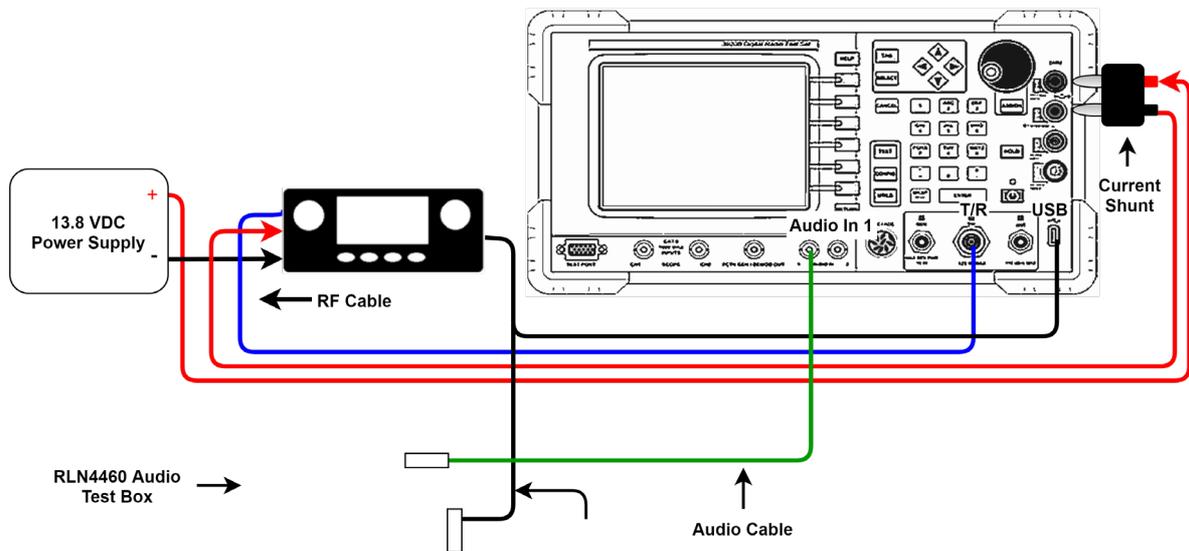
1. Connect a 12 VDC power supply to the RLN4510 or battery eliminator.
2. If the RLN4510 is not available, set the power supply to 7.5 VDC. The power supply should be rated at 5 Amps.
3. Connect radio ANT to 3920 T/R port.
4. Connect radio programming cable to 3920 USB port.
5. Connect radio programming cable to RLN4460 audio test box and audio cable to 3920 Audio In 1 port if performing audio tests.



MOTOTRBO Mobile Interconnect

1. Connect radio TX Out to 3920 T/R port.
2. Connect radio programming cable to 3920 USB port.
3. Connect power supply to mobile with positive lead through the current shunt if PA BIAS alignment is to be performed. The current shunt is not required for power testing.
4. 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.
5. Connect radio programming cable to RLN4460 audio test box and audio cable to 3920 Audio In 1 port if performing audio tests.





Access to the Application through Auto-Test II

1. On the 3920, press the CONFIG key (twice) to gain access to the System menu and select Auto-Test II. This can also be accomplished by right clicking with a mouse and selecting Auto-Test II.
2. Select the Motorola MOTOTRBO Auto-Test from the Auto-Test II menu.

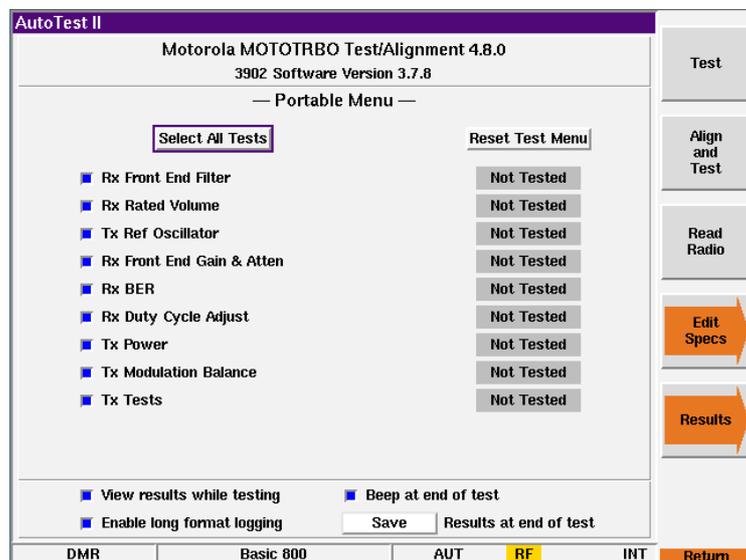
Test Screen - Test Selections

The selections on this screen allow any combination of tests or alignments to be performed. The application will not attempt to perform invalid operations on the radio if the test or alignment is not supported by the radio that is connected.

When first accessing the test screen, use the Read Radio key to query the radio. Note that most of the test options are not selectable initially until a radio is read.

Select All Tests - This will enable all tests.

Reset Test Menu - This will disable all tests.



View Results while testing

- When selected and the test or alignment function has been executed, the screen will change and will display all tests and alignments as they occur. If not selected, the application will stay on this screen and show only the current status, Testing / Passed / Failed / Skipped.

Beep at end of test

- The 3920 will produce an audible beep at the completion of all tests and alignments to notify the operator that the test or alignment is complete.

Enable long format logging

- Diagnostic mode that shows all adjustments to soft pot values.

Results at end of test

- Determines what the 3920 does with the current test results after the test is complete. The options are Ask, Save (default), Print, Save & Print, or Skip.

Test Screen - Function keys

F1 – Test

- Starts testing the radio. No alignments will be made. A test report of Pass / Fail results will be recorded.

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.

F3 – Read Radio

- This will query the radio and determine the model of radio under test. Before this is performed, not all options will be available, such as Test or Align and Test.

F4 – Edit Specs

- 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 –Results

- Views results of the last test performed. Also allows test results to be copied to a USB drive.



Note: Motorola recommends retuning of radios only if it is a part of an issue resolution or engineering recommendation. Reference oscillator should be checked and tuned (if necessary) for radios in storage for six months or more.

Edit Specs Screen

Info lines

- Allows three lines of user text to be entered that will be visible at the beginning of the printout in the Test Results file. These could be used to identify a Technician ID, Company Name or anything that might be useful at the beginning of the printout.

F1 – Save As

- Save all modifications to specifications to a user specified file. Information on all models is saved in a single file.

F2 – Save

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

F3 – Recall

- Recall a saved specification file from memory.

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 specifications to the factory defaults. Note, these values are not permanently stored unless you answer yes when prompted or press the Save Key. This does not impact Radio selection, Info lines, Offset or cable selections.

** This operation should be performed after updating the application to a new version.

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.

Copy

- Copies currently selected Cable to:
 - All Portables
 - All Mobiles
 - All Radios
- Additionally allows copying entries in the info lines to the selected list.

Note: This will automatically save to the currently selected specification file.

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 a *negative* 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.

Note: If it is not possible to perform the cable sweep, enter a fixed negative value in the offset field to compensate for the connecting cable. This value will be used at all frequencies to compensate the power meter. A higher loss value entry would cause the Power meter to read higher values.

- The offset entry will be applied in addition to a cable loss selection.

Power Levels

- For Portables and Mobiles, the default values should match the MIN and MAX values in the radio's code plug. These are the TEST MODE power levels that Auto-Test uses. Auto-Test cannot transmit the user programmed power levels.

Reference Oscillator

- These values are used for test evaluation only. If Alignment is selected, the radio will be aligned to within 30 Hz error. 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.

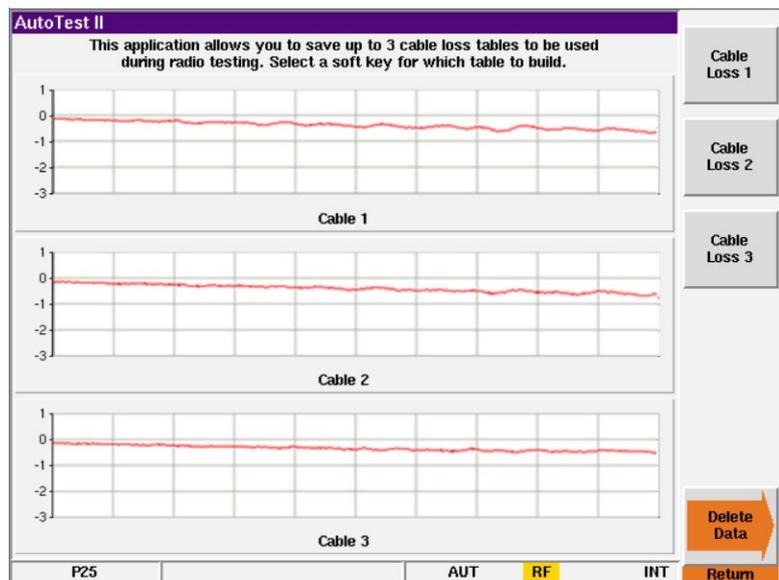
Cable Loss Screen

Cable 1 - 3

- Choose up to 3 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

- Deletes cable data.



Test Cable Calibration

Reference Cable

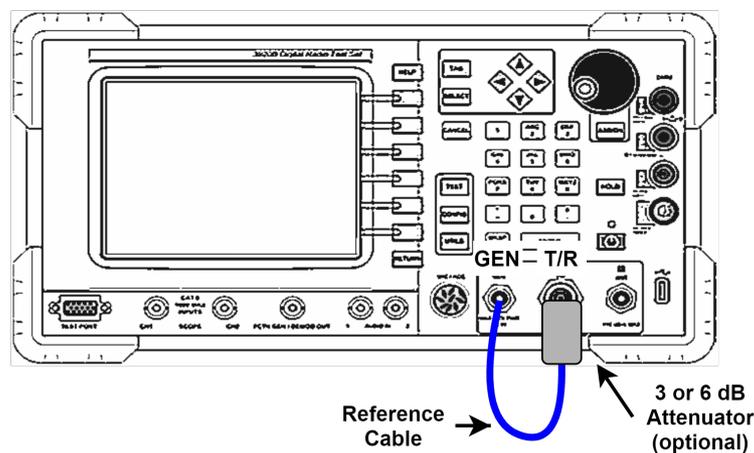
- The 3920 will use its spectrum analyzer and tracking generator to sweep a reference cable and will establish this sweep as a zero reference.
- This cable is used ONLY for calibration purposes and will not be used for testing the radio.

Getting more accurate results

- To obtain better results from this process, use a 3 or 6 dB attenuator at the end of the reference cable that is connected to the T/R port of the 3920. This will improve the VSWR of the cable when it is connected to the Radio Testing Cable.

Reference Cable Sweep

- Gen port -> Reference Cable -> 3 or 6 dB Attenuator (optional) -> TR port



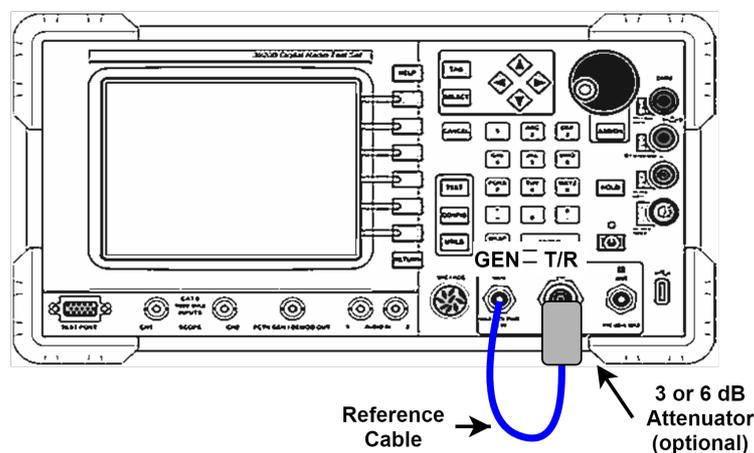
Radio Testing Cable Sweep

- 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 or 6 dB Attenuator (optional) -> Adapter -> Radio Testing Cable -> TR port

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



Results of Cable Calibration

Cable 1

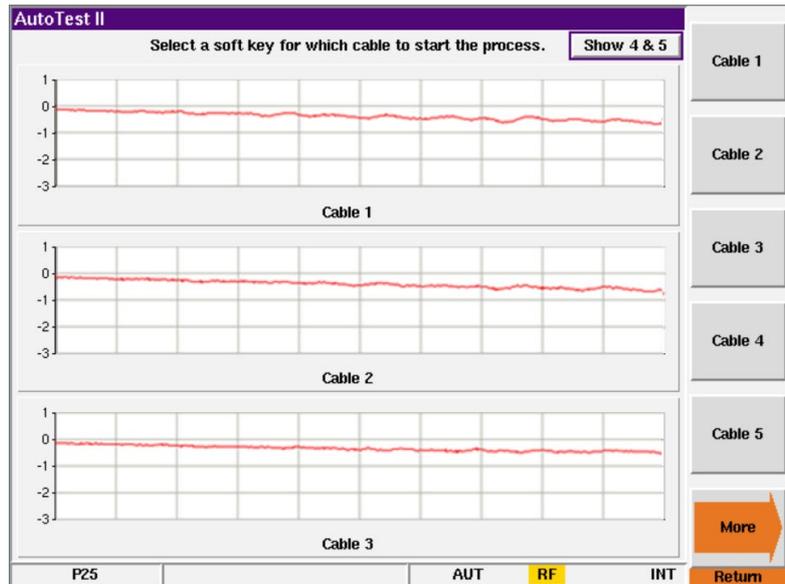
- This calibration was performed as directed without the use of the 6 dB external attenuator.

Cable 2

- This calibration was performed with the same Radio Test Cable but a 6 dB attenuator was used as explained above.

Cable 3

- This calibration was performed with the external 6 dB attenuator and a high quality, low loss, double shielded Radio Test 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 Cable 1 response is not as smooth as the Cable 2 response. These waves are caused by a VSWR mismatch at the point where the cables are connected together. Use of the 6 dB attenuator 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.

Motorola MOTOTRBO™ Auto-Test and Alignment 3920B Radio Test Platform

Results

Displays the most recent test result.

- 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 flash drive.

Clear Results Data

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

The screenshot displays the 'AutoTest II' window with the following content:

```

AutoTest II
Freq: 414.175000 MHz Magnitude Error: 0.23 % PASS
Freq: 425.175000 MHz Magnitude Error: 0.22 % PASS
Freq: 436.625000 MHz Magnitude Error: 0.19 % PASS
Freq: 447.775000 MHz Magnitude Error: 0.17 % PASS
Freq: 458.775000 MHz Magnitude Error: 0.27 % PASS
Freq: 469.825000 MHz Magnitude Error: 0.19 % PASS

Tx Symbol Deviation Test (1944 +/- 195 Hz)
Freq: 403.175000 MHz Syn Dev: 1926 Hz Diff: -18 PASS
Freq: 414.175000 MHz Syn Dev: 1934 Hz Diff: -10 PASS
Freq: 425.175000 MHz Syn Dev: 1936 Hz Diff: -8 PASS
Freq: 436.625000 MHz Syn Dev: 1934 Hz Diff: -10 PASS
Freq: 447.775000 MHz Syn Dev: 1932 Hz Diff: -12 PASS
Freq: 458.775000 MHz Syn Dev: 1932 Hz Diff: -12 PASS
Freq: 469.825000 MHz Syn Dev: 1932 Hz Diff: -12 PASS

Tx Tests (01:31): PASS

-----
Test Results
Tx Reference Oscillator Test : PASS
Rx BER Test : PASS
Tx Broadband Power Test : PASS
Tx Tests : PASS

Time Taken: 03:35
  
```

On the right side of the window, there are several control buttons: Load File, Print Results, Clear, Copy Results to USB, and Clear Results Data. At the bottom of the window, there are mode selection buttons: DMR, AUT, RF (highlighted), and INT, along with a Return button.

Running the Auto-Test, Step by Step

1. Select the Auto-Test II system and select the Motorola MOTOTRBO Auto-Test.
2. Connect the Portable or Mobile radio to be tested and select “Read Radio”.
3. Edit Specs Screen
 1. Verify specifications are set appropriately.
 2. If cable loss factors have not been created, then access the Cable Loss screen and either sweep the test cable or enter appropriate correction factors if known.
 3. Select the cable to be used for this radio on the Edit Specs screen.
 4. Press Return.
4. Main Test Screen
 1. Select the tests or alignments to be performed.
 2. Press the Test or Align and Test softkey.
5. Failed tests should be confirmed by re-testing.